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A Study of Environmental Health and Safety Programs at Research Colleges and Universities

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A STUDY OF ENVIRONMENTAL HEALTH AND SAFETY PROGRAMS AT RESEARCH COLLEGES AND UNIVERSITIES

By

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To my brother, *Jimmy*.

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ABSTRACT

Universities and colleges in the United States are vital communities, teeming with people and vast resources. Because of such factors as class schedules, on-going research, tight academic calendars and highly transient populations, these communities function with diverse operations that need a constant degree of normality for maximum effectiveness. Due to the specialized nature of higher education institutions, universities and colleges are vulnerable to a wide range of situations capable of upsetting normal day-to-day operations. For any university or college, the safe operation of campus is essential to the goals of the institution, the quality of the environment, and even its survival.

Among higher education institutions, the issue of safety is a broad and encompassing concept but often with no clear lines of responsibility. In contrast to industries, which have special units or groups of people to plan and deal with disruptions or emergency situations, higher education institutions often overlook or even ignore safety concerns. Among most industries, especially those involving work with volatile chemicals or other substances as well as dangerous activities, safety is an essential element of sound management.

To address the safe operation of a campus, every higher education institution in the United States has, in one form or another, has an environmental health and safety (EH&S) program. The main principle of an EH&S program is to support and advance the teaching and research activities of the institution through the promotion of a safe and healthy campus, by providing and coordinating services that minimize the risk of occupational illness, injury or environmental contamination. Given the diversity that characterizes the array of colleges and universities in the United States in the 21st century, it is important to know the structure of EH&S programs in higher education institutions and how they are implemented. However, few, if any, studies have been conducted to examine what EH&S programs are comprised of, what role they play in higher education institutions, how they are organized and structured, how they are funded and staffed, and what effect they have on the risk of accidents or the fiscal impact to institutions.

This study have determined that for research institutions, the staff and funding of EH&S programs have significant impacts on the safe operation of the institution. In particular, EH&S staff number has a significant impact on the number of reported injuries and illnesses and the number of lost workdays. The study also found that there are two types of organizational

structures for EH&S programs: a centralized EH&S program, where all the components are within a dedicated EH&S program; and a fragmented structure where the components are disjointed from one another and would report to the institution's higher administration directly and separately. However, the study found that the EH&S organization structures reporting schemes are not significant in ensuring the safe operation of the institution. Furthermore, the study found that EH&S program expenditures significantly affect the safety goal.

CHAPTER ONE

INTRODUCTION

1.1 Background

Each autumn, colleges and universities prepare for new and returning students. For students, going to college can be exciting and confusing. From learning how to navigate the campus to the thrill of being away from home for the first time, it is no wonder that many college students feel overwhelmed. Typically, concerned parents worry about their child's readiness to leave home, their well being, and most importantly their personal safety. Most often when parents think about campus safety, it is in reference to public safety issues such as crime or violence, but few parents are concerned about the *other* safety issues associated with colleges and universities.

Far beyond what gets reported in the evening news, higher education institutions must control a wide variety of safety and environmental hazards to ensure the safety of students, faculty, staff and even visitors. These hazards include: fire, natural disasters, life/building code issues, indoor air quality concerns, management and abatement of asbestos in older buildings, and dealing with other unique hazards such as school shootings and suicides.

At colleges and universities where physical or natural science research is conducted, there are additional safety concerns. Research universities must ensure that dangerous materials are properly handled and are disposed of in a safe manner. Chemical, biological, and radioactive materials used in teaching and research laboratories as well as medical research facilities must be safely handled and properly disposed of by the institution.

Hurst and Kahill (1986) cited the need for universities to have adequate health and safety programs but also found that health and safety programs were often ignored in universities and colleges because of their diverse nature while in industry they were given considerable attention. This is due to the unique differences between academic and industrial settings. Higher education institutions have both academic and nonacademic elements. The nonacademic elements include support services such as food preparation, facility and maintenance and other physical plant operations. In these types of operations, it is often difficult to assign accident prevention responsibilities since often the line of authority is either non-existent or lacking in clarity.

Among the factors that Hurst and Kahill (1986) cited in determining the ineffectiveness of a university or college's accident prevention program were lack of training, little top-level support, no clear line of recognition, and no defined site of responsibility. In terms of responsibility specifically, there should be a central administrator responsible and accountable for the program, and that this individual should have four responsibilities: (1) to oversee the program director who is directly responsible for the conduct of the program; (2) to influence others in directing the safety related activities under their control; (3) to advise the president of the institution concerning safety related matters; and (4) to advocate for the program during budget planning.

Chalfen (1982) noted that colleges and universities differ in many respects, such as size, type and variety of work done within the institution, as well as the philosophy of administration with regard to health and safety. The fact that some effort is required by the Occupational Safety and Health Administration (OSHA) regulations can be considered another major influence that can be either helped or undermined by the perspective or attitude of a college or university administration. Chalfen examined the specific needs of a large institution, the Massachusetts Institute of Technology, which was faced with major safety issues such as the disposal of radioactive waste and other toxic materials from laboratories. Through this research, it was clearly demonstrated that the health and safety program in a scientific institution would differ from such a program in a liberal arts oriented institution, though the basic goal in each case was the same, to ensure health and safety.

While many, if not most, colleges and universities have all-inclusive environmental health and safety (EH&S) programs, there is little existing research on what all-inclusive EH&S programs are comprised of, what their functions are, what responsibilities they play in higher education institutions, how they are organized and structured, how they are funded and staffed, and what effect they have on the risks of incidents and accidents at the institutions. Because the safety issues that these programs deal with vary from one institution to another; this study focused on all-inclusive EH&S programs for research colleges and universities based on student enrollment population size. This data allowed for analogous institutions to be compared and evaluated to determine if the elements of their individual EH&S programs have an impact on risk of accidents and incidents.

1.2 Purpose of the study

The purpose of this study was to gain a better understanding of EH&S programs for various types of research colleges and universities based on student enrollment population size and to develop models of EH&S programs for the various research colleges and universities. Models are reasonably simplified representations of real world situations. They are abstractions of reality. By representing EH&S programs in different models, higher education professionals can easily see what EH&S programs are comprised of, what their functions are, what role they play in higher education institutions, how they are organized and structured, how they are funded and staffed, and what effect they have on the risk of accidents and incidents to institutions.

Ultimately, these models allow institutional administrators to determine if their EH&S program has the proper components in place for preventing and managing institutional EH&S issues and concerns. Knowledge gained about the reporting structure of EH&S programs and the number of reporting levels can aid higher education administration professionals in determining if they are effective in their management. Knowledge about expenditures will provide administrators with a better understanding of how EH&S funds should be allocated to be most effective for their institution. Finally, knowledge gained about the number of EH&S audits and violations from federal, state, and local authorities can assist administrators and other professionals in determining if their institution's EH&S program is effective by being fiscally and environmentally responsible.

1.3 Research questions

To examine the organizational structure, program funding, staffing, and components that make up an EH&S program and to determine what effect they have on the risk of accidents and incidents to the institution, this research study specifically addresses the following questions:

- *What are the main components of an EH&S program, how are they staffed for research colleges and universities, and what effect do they have on the risk of accidents and incidents to the institution?*

The independent variables (IV) for this research question are the number of EH&S components and number of staff per component. The dependent variable (DV) for this research question is the number of reported injuries and illnesses, lost workdays, and the number of audits and violations from federal, state, and local authorities.

- *Does the organizational structure of the EH&S program have an effect on the risk of accidents and incidents to the institution?*

The IV for this research question is the number of EH&S reporting levels. The DV for this research question are the numbers of reported injuries and illnesses, lost workdays, and the number of audits and violations from federal, state, and local authorities.

- *To what degree does the expenditures of an EH&S program effect the risk of accidents and incidents to the institution?*

The IV for this research question is EH&S program expenditures. The DV for this research question are the numbers of reported injuries and illnesses, lost workdays, and the number of audits and violations from federal, state, and local authorities.

The research hypotheses based on the research questions are:

- *The components and staff per component in an EH&S program will have an effect on the risk of accidents and incidents to the institution.*

- *The number of reporting levels in the organizational structure of an EH&S program will have an effect on the risk of accidents and incidents to the institution.*

- *Funding for an EH&S program will have an effect on the risk of accidents and incidents to the institution.*

1.4 Constructs

The constructs in the study are EH&S programs in research college and university settings. Within the context of an EH&S program, the primary constructs consist of: composition of the program, the organizational structure, program expenditures, staffing, and risks of incidents and accidents. The construct of risks of incidents and accidents consist of the numbers of reported injuries and illnesses, lost workdays, and the number of audits and violations from federal, state, and local authorities.

1.5 Definitions of terms used in the study

The terms used for this research are defined as follows:

Biological Safety: The component of an EH&S program that is tasked with ensuring proper disposal of biohazardous waste, safe use of biological materials in research, control of exposure to bloodborne pathogens, and proper food safety in higher education institutions. In addition, this component ensures that the institutions are in compliance with state and federal regulations. Services for this component include laboratory and workplace inspections as well as training for students, faculty, staff, and guests (U.S. Department of Health, 2007).

Building Code/Life Safety: Defined by Florida Statutes, Chapter 553.80 (2009), the component of an EH&S program that ensures that all of a higher education institution's building erections, additions, alterations, repairs, remodels or demolitions and installations of building systems meet local, state and federal regulations requirements.

The Campus Safety, Health & Environmental Management Association (CSHEMA): Originally called Campus Safety Association, provides services to colleges, universities, and research communities by providing information to environmental health and safety professionals in the education and research communities (CSHEMA, 2008).

Chemical Safety: The component of an EH&S program that provides resources and support for reducing potential chemical and environmental hazards associated with chemicals in laboratories and workplaces. The chemical safety area is tasked with ensuring higher education institutions are in compliance with state and federal regulations. Services offered include hazardous waste disposal, laboratory and workplace inspections, and training for students, faculty, staff, and guests (Centers for Disease Control and Prevention, 2009).

Emergency Management: As described by the Florida Statutes Chapter 252 (2009), the component of an EH&S program that ensures a higher education institution is prepared to respond to, recover from, and mitigate the effects of a wide variety of disasters that could adversely affect the health, safety, and/or general welfare of its students, faculty, staff, visitors, and families.

Environmental health and safety program component: A specific section within an EH&S program that helps ensure the overall health and safety of the institution. Examples of these components would include: biological safety; chemical safety; radiation safety; laboratory safety; building code/life safety; fire safety; risk management, industrial hygiene, and emergency management.

Environmental health and safety program: An organization within a higher education institution that oversees the safe working environment of the institution as well as addresses the institution's concerns during time of crisis. In addition, this organization ensures that federal, state, and local regulations and guidelines are being met.

Fire Safety: The Florida State University, Department of Environmental Health and Safety (2010) defines fire safety as the component of an EH&S program that ensures the continuation of a fire-safe environment through inspection, education, and equipment resources inspections. In addition, this component ensures that the higher education institutions are in compliance with state and federal regulations.

Industrial Hygiene/ Occupational Health: United States Department of Labor (2010) defines this component of an EH&S program that is responsible for anticipating, recognizing, evaluating and controlling workplace conditions that may cause worker injury, illness or discomfort for a higher education institution. The primary concern of industrial hygiene is to minimize occupational health and safety hazards and to ensure compliance with the Occupational Safety and Health Administration (OSHA) health and safety regulations.

Laboratory Safety: The Florida State University, Department of Environmental Health and Safety (2010) defines this as the component of an EH&S program that provides assistance to research laboratories to ensure that they are safely set-up. Laboratory Safety may also be tasked with advising researchers about training, record keeping, inspections, and compliance with regulatory agencies; assisting researchers on obtaining necessary exemptions and licenses from state and federal agencies to purchase and possess controlled substances to be used in research, and addressing general and specific safety concerns in research laboratories.

Research higher education institution: Based on the CSHEMA 2008 Benchmarking Report, these institutions are four year colleges or universities that conduct natural and/or physical science research and have a student enrollment greater than 5,000. For the Carnegie size and setting classification (2010), these institutions are medium four-year, primarily residential, baccalaureate colleges.

Risk Management: Outlined in Florida Statutes Chapter 284 (2009), *State Risk Management and Safety Programs*, this component of an EH&S program, would identify, assesses, and prioritize risky activities or events to minimize, monitor, and control the probability of unfortunate events to the institution. This component is the primary provider for the higher education institution’s property, liability, workers' compensation, and special insurance needs. Its function is to assist in obtaining coverage, processing claims, and seeking reimbursement from insurers when the institution is entitled to restitution due to a loss caused by another party.

Radiation Safety: The Florida Administrative Code (2010) Chapter 64E-5, *Control of radiation hazard regulations*, defines this component of an EH&S program that ensures higher education institutions are safe from radiological hazards associated with the use of radioactive materials used in research, radiation producing machines, and lasers used in laboratories and workplaces. This component is also tasked with ensuring all use of radioactive materials and devices are in compliance with state and federal regulations. Services offered include radioactive waste disposal, laboratory and workplace inspections and monitoring, and training for students, faculty, staff, and guests.

1.6 Significance of the study

As part of the education system, colleges and universities are established for the goals of academic study, talent cultivation, cultural enhancement, social service, and promotion of national development (Wu, 2008). Furthermore, the activities of colleges and universities should encompass many disciplines, be well integrated, show evidence of innovation, and include a search for excellence. These activities mean that colleges and universities should function as a cradle for breeding and fostering great scholars, philosophers, and intellects. In other words, colleges and universities are nurseries for nurturing the future intellectual elite. As such, colleges and universities should have high-quality academic programs, substantial education and research facilities, and a high level of workplace safety (Wu, 2007). To guarantee these ideals are met, colleges and universities must ensure campuses are safe and conducive for these activities to occur. To ensure these safety measures are in place, colleges and universities' health and safety programs should be up to date.

The educational significance of this study will advance the existing body of knowledge in the field of EH&S programs in order to improve instructional practices of responsible fiscal and environmental stewardship of higher education institutions and to promote safety across the institutions in which they serve. In addition, the study and models therein will provide higher education administration professionals with a better understanding of the EH&S program within their institutions and ways they can make those programs more effective and safe.

1.7 Conceptual framework

A conceptual framework, Figure 1.1, was created to show how this study was carried out. For this study, mock EH&S programs were developed for the various types of research higher education institutions based on student enrollment population sizes. The first phase of the study utilized an exploratory study to determine the various types of EH&S program composition, how EH&S programs are organized and structured. The second phase of the study examined: EH&S staff, organization levels, and expenditures to determine what effect they have on the risk of accidents and incidents to the research institution. Following the exploratory study, the third phase of the study was the development of EH&S programs models for research higher education institutions that are based on student enrollment population sizes.

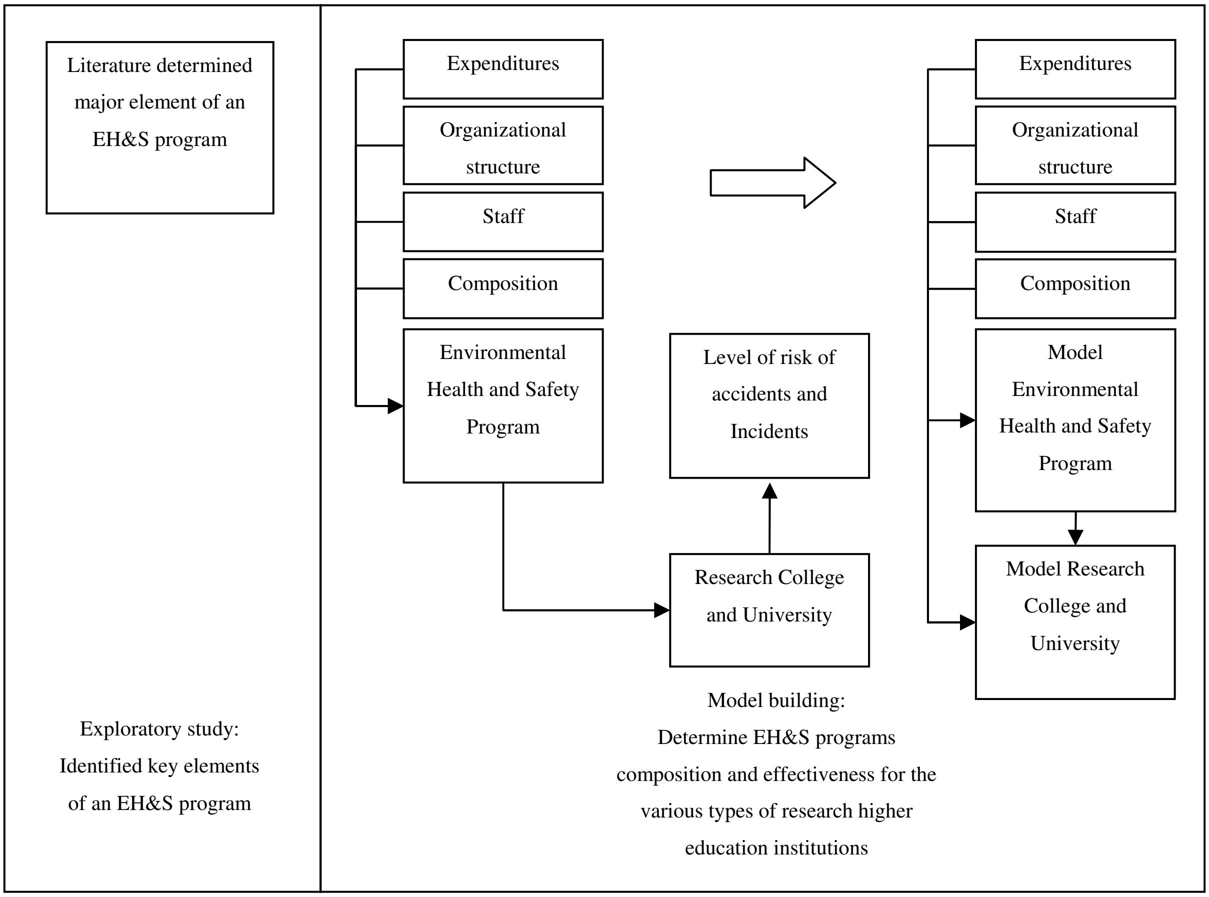

Figure 1.1: Conceptual model

1.8 Assumptions

Since limited research has been done on EH&S programs and their impact on research colleges and universities, this study utilized the *Campus Safety, Health & Environmental Management Association (CSHEMA), 2008 Benchmark Report* as the data source to help describe and define EH&S programs for research colleges and universities. CSHEMA is an organization comprised of college and university safety professionals whose focus is on ensuring the safety of higher education institutions. It is assumed that the information provided by the institutions in the survey for the2008 CSHEMA Benchmarking Report is accurate and honest. Another assumption in the study was that as institutions grow in terms of research dollars, student enrollment and faculty; if the EH&S programs do not grow in terms of components, staff and funding, the risk of adverse incidents to the institution will rise. These assumptions are based on the researcher's observations that research higher education institutions that have grown in terms of enrollment and research have needed an increase in EH&S funding and staff to ensure safe and proper support of the teaching, and research activities at the institution with the minimum number accidents.

1.9 Limitations

Several limitations influenced the results, findings and conclusions of this study. The sample used in the 2008 CSHEMA Benchmarking Report was limited since the number of institutions selected in the data use for this study may be too small a percentage of the target population. Consequently, the results and the models may not lend themselves to generalize to the entirety of research higher education institution populations. Another limitation of the study was its restriction to the types of research higher education institutions that are based on student enrollment population sizes that conduct natural or physical science research. The types of research higher education institutions as defined by the 2008 CSHEMA Benchmarking Report are: Very Small Research University/College with student enrollment less than 5,000; Small Research University/College with student enrollment between 5,001 to 12,000; Research University/College with student enrollment between 12,001 to 20,000; and Large Research University/College with student enrollment greater than 20,000. Findings from the study could only apply to these types of institutions.

1.10 Delimitations

Restrictions placed on the study by the researcher were as follows: The exploratory study and model development was limited to those research higher education institutions that are in the CSHEMA 2008 Benchmarking Report, have a student enrollment greater than 5,000, and have an EH&S program. Also, the study defined the specific types of EH&S components that were used and certain data points in the 2008 CSHEMA Benchmarking Report that were used. the data points that were used in this study were; Component of an EH&S program, the organizational structure of EH&S programs in terms of number of reporting levels, total program expenditures, program staffing, numbers of reported injuries and illnesses, lost workdays, and the number of audits and violations from federal, state, and local authorities. Other EH&S related components and data points in the 2008 CSHEMA Benchmarking Report were not included in this study as they were not identified components from the literature review.

1.11 Summary

Nearly all colleges and universities in the United States have Environmental Health and Safety (EH&S) programs. However, few, if any, studies that have been conducted to examine and explore what EH&S programs are comprised of, how they are organized and structured, how they are staffed and funded, what role they play for higher education institutions and what effect they have on of risks of accidents at the institutions. This study provides a foundation for the study of EH&S programs for research colleges and universities and the effect they have on risks of adverse incidents at the institutions. This study further contributes to the limited knowledge and literature regarding EH&S programs in higher education institutions. Results of this study provide a baseline for additional research on this topic in the future and promote the understanding of these programs.

CHAPTER TWO

REVIEW OF THE LITERATURE

The question of how to handle and manage health and safety on campus has always been a challenge for colleges and universities. The literature reflects the recognition that when handling and managing aspects of health and safety, these aspects are unique and are often dealt with as individual components of the overall environmental health and safety (EH&S) program. Most often, whether an institution is public or private, large or small, can influence the design, implementation, operation, administration, and funding of an EH&S program. Therefore, one basis for such research is the simple determination that there is a need for this type of program and that special efforts must be made to design, develop, implement, and operate such an EH&S program.

A literature search revealed that the difficulty with a study of this type is that higher education institutions have to deal with a wide variety of environmental health and safety concerns. An extensive literature search of federal, state, and local regulating entities as well as professional organizations related to health and safety in higher education institutions illustrated that regulating entities and professional organizations do include health and safety program elements; however, they are often specific to their areas of specialties; such as chemical use and disposal regulations, building code requirements for facilities being built, radioactive materials use regulations, and so on. Furthermore, regulating bodies and professional organizations are more concentrated on industry standards that higher education institutions have to meet rather than an overall aspects of environmental and safety in higher education institutions.

2.1 Foundations of health and safety programs

A search of the literature, dating back to the 1970's, yielded reports from a number of academic institutions on the creation of various types of EH&S programs. Carsey and Hunt (1983) offered information on this subject based on questionnaires sent to colleges and universities with enrollment of 15,000 or more students. The data gathered included specific program and salary distributions, program area responsibilities, and materials used in such programs, all aimed at aiding institutions who might want to expand or develop similar EH&S programs.

Brown (1980) described the University of Michigan's organizational system as an attempt to address environmental health issues in a comprehensible manner that would include the management of regulatory liaison functions. A study by Webb (1977) described the reorganization of Indiana University- Bloomington as a fragmented set of environmental health and safety functions into one administrative network that made the system more responsive, accountable, and controllable. Koren's (1973) study discussed the Department of Health and Safety at Indiana State University internship program's criteria for setting up and analyzing the effectiveness of its internship program in health and safety.

Hartzog's (1981) dissertation study offered a more general descriptive study of emergency assessment planning at public institutions of higher education with enrollment of 5,000 or more students. In this study, he described four planning elements that were used as a framework for his discussion: (1) objective, (2) strategies, policies, and plans, (3) organization and (4) review and evaluation. This study was based on a survey by the Emergency Management Planning Survey developed by the author to collect information from staff members at 312 concerned institutions. Of those, 166 institutions responded. The research found that emergency management planning at colleges and universities had increased overall during the previous ten year period. Administrators at nearly one-third of the institutions that responded considered emergency management planning of major importance.

In addition, Hartzog (1981) noted that the responsibility for emergency management planning was assigned to a wide variety of institutional offices or agencies, though it was most common for supervisory responsibility to rest with vice presidents for administration, operations, business, or finance. Direct responsibility was most often assigned to directors of security, public safety, or environmental health and safety department. The research also found that while planning was common, it was less centralized and more diverse than in other types of communities with emergency management functions.

2.2 Assessment of need

Satterfield (1972) provided an analysis of the responsibilities for academic institutions under the Occupational Safety and Health Act (OSHA) of 1970. The purpose of the Act was to ensure that a work place is free of potentially recognized hazards for all employees. The law applied to all employers except federal, state, and local governments and agencies created by governmental bodies. However, in the law, there are provisions that allow individual states to assume state jurisdiction. The OSHA law, therefore, applied only to institutions in the private sector, however, most often public institutions would also follow these guidelines. Consequently, the basic obligations of public colleges and universities are: to provide adequate medical facilities for employees; to maintain a log of all injuries and occupational disease claims deemed necessary for a doctor to treat; and to coordinate the different activities of advisory personnel to see that the basic mandate is carried forth.

Loofbourow, Holdstock, and Cooper (1973) reported on the functions and organization of the Occupational Health and Safety Program at the University of California at Davis (UC Davis), a publicly supported institution that was not covered by OSHA at the time but addressed many of the Act's safety concerns. The environmental health and safety aspect of the UC Davis Program was centralized under the authority of the chancellor's office as a separate office charged with the maintenance of an environment that would not adversely affect the health or safety of students, staff, and visitors. The development of this office was in response to a growing concern for environmental health and safety during the years to follow that lead to the development and inclusion of other safety related programs into the office.

2.3 Attitude

The demands of an EH&S program include not only economic and administrative elements but also social and psychological factors which can affect the outcome. The research of Needle and Sawlewicz (1978) presented a study to examine social and psychological factors accounting for satisfaction and dissatisfaction at work and as it related to levels of job satisfaction to physical and psychological well-being. The authors noted that health, work, and the environment are among the most prominent concerns confronting society and described how these concerns affect policy makers.

In the study, 887 male and female employees at a large mid-Atlantic university completed a questionnaire on issues of job satisfaction, health characteristics, and psychological well-being (Needle & Sawlewicz, 1978). Job satisfaction was made a function of those variables associated with occupational status, and overall satisfaction was found to be highest among the occupational groups with the highest job status. Health status also appeared to be related to the type of occupational group. Those in lower occupational groups had lower job satisfaction and also showed more health problems. A major implication drawn from this data was that the relationship between job satisfaction and physical and psychological well-being indicates the need to modify certain job characteristics to minimize or eliminate unnecessary stressors, and health professionals from many different disciplines can play a role in promoting a healthful and safe work environment.

Typically, researchers working in higher education institutions are highly educated. Many of them are graduate or post-doctoral students researching their thesis or trying to discover the next innovative advancements in their field. Given their education level, it believed that these individuals have a clear understanding of the occupational risks and safety issues within their research and have a high regard for safety procedures. However, these individuals often do not perceive safety practices as a priority until they are involved in an accident. They tend to learn more from personal experience than from attending a mandatory safety training or reviewing safety literature about the hazards encountered. Many of the injuries sustained by personnel are primarily cuts, bruises, sprains, strains, and fractures. However, overt exposures have been documented resulting in serious injuries and fatalities (Ogren, 2003). Prevention of injuries and exposures begins by ensuring that individuals are aware of the hazards present and willing to take the necessary safety precautions to avoid them.

In addition to support from university safety professionals and supervisors, principal investigators (PI) play a vital role in educating personnel about the inherent risks associated and the safety issues within their university or college work environment. Principal investigators have the responsibility for training students and staff about the hazards and risks associated with their research and how to deal with them in a safe manner. However, they tend to circumvent basic safety procedures to expedite an experiment because of their familiarity with the procedures and their confidence in their use of the materials. These methods are learned by the less experienced researcher and may create unsafe working conditions, causing possible injury to the individual. It also perpetuates cycles of unsafe work behaviors and practices that are passed on to other research personnel (Ogren, 2003).

Furthermore, discussions relating to safety on campus most often focus on public safety issues. As a recent example, evaluating the development of campus safety policy in the higher education institutions following the mass shooting at Virginia Polytechnic Institute and State University (Virginia Tech) on April 16, 2007, and more recently a student who was decapitated, also at Virginia Tech (Lindsey, 2007) was and will be the focus of many studies. Most often theses studies dealt with wide variety of issues such as responding to public safety concerns.

In June 2007, following the Virginia Tech shooting, the governor of Virginia commissioned a panel to review the event (Va. Exec. Order No. 53, 2007). The study chronicled the downward spiral of Seung Hui Cho, a 23-year-old undergraduate senior at Virginia Tech, culminating in the shooting on campus. The study also narrated the university's inability to merge the warning signs and flags scattered throughout the campus at all levels of its administration. In response to the tragedy, the President of the United States assigned the Health and Human Services Secretary, United States Attorney General, and the United States Secretary of Education to meet with state governors and report back "on measures taken to improve security and response to crisis situations on university campuses" (Florida. Executive Order No. 07-77, 2007).

Dealing with this type of safety concern is generally part of the emergency management component of the EH&S program. However, few studies have been conducted in relation to other types of safety concerns on campus. To better understand other safety concerns in higher education institutions; the issue of health and safety in higher education institutions needs to be viewed from an all encompassing EH&S program with its associated components. Some associated safety concerns to be addressed include biological safety, chemical safety, radiation safety, laboratory safety, building code/life safety, fire safety, risk management, as well as industrial hygiene and emergency management.

2.4 Current programs

An extensive Internet search was conducted using an online database system with the assistance of a research librarian to locate articles and studies dealing with current colleges' and universities' health and safety programs. While a limited number of articles were located, those containing information about EH&S programs in higher education institutions in particular were difficult to find. When conducting the search that dealt with the current environmental health and safety in higher education institutions, the results often focused on student health issues or public safety on campus. Since very little current research has been done on EH&S programs that are all-inclusive safety programs in higher education institutions, the search focused on the components that are associated with EH&S programs in higher education institutions.

Using the established work by Carsey and Hunt (1983) as a foundation to establish what components need to be included in an EH&S program; and using the Florida State University Environmental Health and Safety Department as a template for an all-inclusive EH&S program, the review noted that there are eight components in such a program. The components are: biological safety, chemical safety, radiation safety, laboratory safety, fire safety, risk management, industrial hygiene/ occupational health, and emergency management.

2.4.1 Biological safety

Of the three major safety concerns in academic research, biological safety is the newest among radiation, chemical, and biological safety. Biological safety has always been of some concern in academic settings, however, it began to gain notice and take shape during 1980s with the discovery of the Human immunodeficiency virus (HIV), the virus that can lead to acquired immunodeficiency syndrome (AIDS), a condition in which the immune system begins to fail, leading to life-threatening opportunistic infections to take over the body (The American Biological Safety Association, 2009). With recent concerns about bioterrorism and new bio-defense research programs, biological safety has again become a major concern in academic research (The White House, 2004).

With the threat of bioterrorism, a number of federal agencies have instituted funding for critical, new bio-defense research. Funding for bio-defense provides many opportunities for university researchers; however, in order for these researches to proceed, such research must be conducted in a safe and ethical manner. As highlighted by the anthrax attacks that followed the events of September 11, 2001, scientists and physicians have been made suspects as well as saviors. Bio-security is defined as the protection of high-consequence microbial agents and toxins, or critical relevant information, against theft or diversion by those who intend to pursue intentional misuse (U.S. Dept. of Health, 2007). With bio-security becoming the main focus for academic research instead of the safety concern; a myriad of new oversight regulations present a real challenge to the research and safety communities. Compliance with these regulations is essential if the academic research community is to maintain the public trust that is essential for the continued support of research. With this in mind, the scientific community must help establish a framework to ensure that bio-threat agents and critical information is withheld from terrorists while permitting the continued advancement of biomedical research in the academic setting. The biological safety component of the EH&S program would carry out the task of ensuring this framework is properly established for colleges and universities.

2.4.2 Chemical safety

Chemical safety awareness can be traced back to the tragedy at a pesticide plant owned and operated by Union Carbide India Limited in Bhopal, Madhya Pradesh, India in December 1984, which released a large volume of toxic gases into the atmosphere. A mixture of poisonous gases flooded the city of Bhopal, causing great panic as people woke up with a burning sensation in their lungs. Thousands died immediately from the effects of the gas and many were trampled in the panic. Following this accident in India, an incident occurred in the United States in which there was a release of Aldicarb Oxime, a chemical used in pesticide, from a facility in Institute, West Virginia. This accident resulted in great public concern about the potential danger posed by major chemical accidents (Kleindorfer et al, 2003). As a result of public concern, three laws were put in place. The first law, which intended to specifically address the problem of chemical accidents in the United States was the Emergency Planning and Community Right-to-Know Act of 1986, which required state and local governments, including public and private colleges and universities, to plan for emergencies and required chemical facilities to report information about chemical hazards to government and the public (United State Code, 1990). The other two legislative programs which addressed chemical accidents were enacted under the Clean Air Act Amendments of 1990 (Code of Federal Regulation, 1990).

Currently, under the Occupational Safety and Health Administration (OSHA), requires facilities having specified hazardous chemicals to implement accident prevention measures designed to protect workers (Code of Federal Regulation, 2006). In addition, the recent amendment to the Clean Air Act Amendments, through the Environmental Protection Agency (EPA), sets forth a series of requirements aimed at preventing and minimizing the consequences associated with accidental chemical releases. The rule applies to facilities, in both public and private sector that manufacture, process, use, store, or otherwise handle regulated substances at or above specified threshold quantities (Code of Federal Regulation, 2000).

Since colleges and universities process, use, store, and handle regulated substances in one form or another, these current laws are being carried out in higher education institutions. Most often, the chemical safety component in an EH&S program would ensure these laws are being followed. As generator of hazardous waste, colleges and universities are responsible for tracking and managing the waste from the point of generation to disposal, known as "cradle-to-grave". Under the state and federal laws, the chemical safety component is the key link in the cradle-to-grave hazardous waste management system. For colleges and universities who are the waste generators, the chemical safety component of the EH&S program determines if waste generated in the laboratory, facility and maintenance operations, as well as other areas that generate hazardous chemical wastes at college and university are properly disposed of.

2.4.3 Radiation safety

Radiation safety in colleges and universities can be traced back to the National Council on Radiation Protection and Measurements (NCRP). The NCRP was chartered by the U.S. Congress in 1964, to formulate and disseminate information, guidance and recommendations on radiation protection and measurements base on the consensus of leading scientific thinking. As a result of the guidance and recommendations by the NCRP, colleges and universities that use radioactive material or regulated devices that produce radiation must have a program that specifies the policies and practices that are necessary to control radiation exposures to its employees, students and the public within the prescribed limits and to levels that are *As Low As Reasonably Achievable* or ALARA (National Council on Radiation Protection and Measurements, 1998).

Since radioactive materials are used in college and university laboratories as powerful research tools in biological and physical research and radiation producing equipment such as x-ray machines, particle accelerators (devices that use electric fields to propel charged particles to high speeds and to contain them in well-defined beams), and sealed radioactive sources (radioactive material encased in metal or plastic) can produce physical injury at high enough energy levels and if radioactive materials were ingested or inhaled, methods of protection and ensure safe use of materials and devices fall within the radiation safety program. Furthermore, the NCRP noted that the radiation safety program objective is to protect people from the deleterious health effects that may result from exposure to radiation. Therefore, the radiation safety component's main function is to reduce the likelihood of accidents through careful facility and equipment design, safety procedures, and training. Program and facility design, and worker training are important to ensure that radiation exposures remain within these limits and are ALARA. In addition, the radiation safety program includes adequate control and evaluation of radiation exposures and radioactive wastes (National Council on Radiation Protection and Measurements, 1998).

Currently the U.S. Nuclear Regulatory Commission (NRC), an independent agency created by Congress, oversees and regulates the safe use of radioactive devices and materials. The state in which the college or university is located determines if that institution is under the jurisdiction of NRC regulations. States that are not regulated by NRC have entered into agreements with the NRC that give the state the authority to license and inspect byproduct, source, or special nuclear materials used or possessed within their borders (United State Nuclear Regulatory Commission, 2009). As an example, in the state of Florida, Chapter 64E-5, of the Florida Administrative Code (2010), Control of Radiation Hazard Regulations and Chapter 64E-4 of the Florida Administrative Code (2000), Control of Non-ionizing Radiation Hazards, regulates the use of radioactive materials and devices.

2.4.4 Laboratory safety

In Taiwan, between December, 1997 and May, 2004, 21 accidents causing injuries and death to students and instructors occurred in university and college laboratories (Wu, 2007). To ensure that accidents like these do not happen in research laboratories, higher education institutions in the United States require their students, faculty and staff agree to and abide by to a wide variety of laboratory safety rules, guidelines set forth by either their specific institutional department, such as its chemistry or biology department, and/or by the institution's health and safety program before they can work in a research laboratory. The rules and regulations for laboratory safety are guided by the OSHA Laboratory Standard, 29CFR 1910.1450, Occupational Exposure to Hazardous Chemicals in Laboratories (Code of Federal Regulation, 1990). In this standard, it is noted that laboratory workers may be exposed to hazardous materials via inhalation, ingestion, injection, contact with exposed skin, and contact with the eyes. The goal of laboratory safety is to inform students, faculty, and staff of the hazards of working with chemicals and to protect them from exposure to hazardous chemicals.

In most instances, the laboratory safety component of colleges and universities' health and safety programs acts as a "catch all" component since it crosses over other environmental health and safety disciplines. The laboratory safety component is often responsible for the protection of the environment and all individuals that may be exposed to hazards associated with laboratories, research support areas, academic studios, and similar settings. This component is also tasked with other duties such as the coordination and oversight of the acquisition and use of prescription drugs, controlled substances, and ether in non-medical or veterinary activities for the college or university. Additionally, the laboratory safety component provides assistance to researchers in obtaining the necessary exemptions and/or licenses to purchase and possess controlled substances to be used in their research as well as assistance with laboratory set-up as it relates to safety and addressing general and specific safety concerns.

2.4.5 Fire safety

From 2005 to 2007, an estimated 3,800 university housing fires occurred annually in the United States. These fires accounted for less than one percent of residential building fires responded to by fire departments across the nation. Fires result in injuries, loss of property, and loss of lives (United State Fire Administration 2009). In 2007, the United States Consumer Product Safety Commission or USCPSC (2007) reported an increase in residence hall and other university housing fires in recent years. Fires are often caused by students who bring items from home to make their college stays more comfortable. Often these creature comforts include high-powered electronic equipment and appliances. This equipment can be dangerous when used improperly or left unsupervised, especially in residence halls. The USCPSC reported that fires are more common during the evening hours and weekends when most students are in the residence halls. Most of the fires are cooking-related (hot plates, microwaves, portable grills, etc.), but the majority of deaths occur in bedrooms. In August 2007, the USCPSC, the United States Fire Administration (USFA) and the National Fire Protection Association (NFPA), urged students, families, and school administrators to be aware of the fire hazards and to take precautions (United State Consumer Product Safety Commission, 2007).

Recent changes to the Higher Education Opportunity Act or HEOA by the Department of Education (2008) have required that higher education institutions that maintain an on-campus student housing facility must collect fire statistics, publish an Annual Fire Safety Report, and keep a “fire log.” These requirements are new and separate from the Clery Act requirements. The Clery Act requires all colleges and universities that participate in federal financial aid programs to keep and disclose information about crime on and near their respective campuses. In order to ensure these revised regulations are being met, the fire safety component of the health and safety program is charged with protecting staff, students, and visitors from unreasonable risks of injury or death from fire emergency.

2.4.6 Risk management

Colleges and universities are exposed to various risks related activities that could jeopardize safety and potential losses to the institution. The risk management component of an EH&S programs seeks to eliminate, prevent or minimize those risks. In order to recognize the need and responsibility to preserve the colleges and universities’ resources, the risk management component develops policies and guidelines for administration of insurance programs and uses risk management strategies to reduce risk related activities. Often these policies and guidelines are mandated by state law. For instance, the State of Florida's guidelines are outlined in Florida Statutes (2009), Chapter 284, State Risk Management and Safety Programs.

As outlined in the Florida's statutes the responsibilities of a risk management would consist of administering policies and best practices that are designed to reduce or eliminate the potential for losses to the college or university. Often, the risk management component works with the institution's community to ensure that a safe environment is provided for faculty, staff, students and visitors, and to minimize loss or damage to the college or university's material assets through the development and implementation of loss-prevention programs and the application of effective risk management principles (The Florida Statutes, 2009).

2.4.7 Industrial hygiene/ Occupational health

Industrial hygiene or occupational health was prompted by the Occupational Safety and Health Act of 1970 or the "Act". This Act led to the creation of the Occupational Safety and Health Administration (OSHA); an agency of the United States Department of Labor whose mission is to prevent work-related injuries, illnesses, and occupational fatalities by issuing and enforcing rules for workplace safety and health. OSHA develops and sets mandatory occupational safety and health requirements applicable to the more than 6 million workplaces in the United States. The Act and OSHA federal regulations cover most workplaces. However, the Act permits states to develop approved plans as long as they provide protection equivalent to what are provided under OSHA regulations (United State Department of Labor, 2010). In most instance colleges and universities would follow the OSHA regulations.

Today, colleges and universities have implemented elements of an industrial hygiene component, occupational health, or hazard communication program to be responsive to OSHA and the Act and its regulations. The industrial hygiene component of the health and safety program often evaluates for potential health hazards and develops occupational safety and health policies and procedures to control these hazards. In addition, the industrial hygiene component anticipates, recognizes, evaluates, and recommends controls for environmental and physical hazards that can affect the health and well-being of the institution. Furthermore, industrial hygiene also plays a major role in developing policies and procedures to protect workers from health hazards associated with toxic chemicals, biological hazards, and harmful physical agents.

This component also analyzes, identifies, and measures potential hazards or stressors that can cause sickness, impaired health, or significant discomfort for those who are exposed to chemical, physical, ergonomic, or biological exposures. The role of the industrial hygiene component is to spot those conditions and help eliminate or control them through appropriate measures (United State Department of Labor, 2010).

2.4.8 Emergency management

The emergency management component is the youngest of the entire health and safety program component. This component came about with the recent changes to the Higher Education Opportunity Act (HEOA) specify that higher education institutions must include a statement of policy regarding emergency response and evacuation procedures in the institution's annual security report. The HEOA states higher education institutions must have procedures to immediately notify the campus community upon the confirmation of a significant emergency or dangerous situation involving an immediate threat to the health or safety of students or employees on the campus. In addition, the higher education institution will take into account the safety of the surrounding community in the notification system, unless the notification will compromise efforts to assist victims or to contain, respond to, or otherwise mitigate the emergency (Federal Register, 2009).

Furthermore, the revised HEOA mandates that higher education institutions must have a description of the process to confirm that there is a significant emergency, determine who to notify, determine the content of the notification, and initiate the notification system to include a list of the titles of the persons or organizations responsible for carrying out this process as well as procedures for disseminating emergency information to the community (Federal Register, 2009).

The revised HEOA also directs that higher education institutions must have procedures to test the emergency response and evacuation procedures on at least an annual basis to include publicizing its procedures in conjunction with at least one test per calendar year, and to document the exercise as well as the date and time of the exercise and whether it was announced or unannounced. To ensure colleges and universities are executing these recent changes accordingly; it is tasked with drafting policies and procedures for the institution.

2.5 Future

Salvato (1988) looked to the future of environmental health protection and felt that the emphasis must be placed on identifying new environmental hazards and provide better information and communication to better educate the public. Kothchian (1988) felt that there has been a lack of understanding on the basic components of an EH&S programs. Kothchian (1988) further noted that these basic components reporting levels need to be made clear to those who overseeing such programs. Bagby (1983) noted that the future of environmental health and safety would depend very much on professionals in their related field. This is due to the professions abilities to carry out tasks requiring specific skills and addressing the many dimensions of EH&S programs.

2.6 Summary

Colleges and universities have to be responsible for a wide variety of hazards that include fire, natural disaster, public safety, and other unique situations such as school shootings. At higher education institutions where physical or natural science research is conducted, there are additional safety concerns. Research institutions must ensure that dangerous materials used in research are being handled properly. Materials such as chemical, biological, and radioactive materials used in teaching and research laboratories and in medical research facilities must be handled and disposed of safely and properly.

This chapter provided a summary of literature on various aspects of safety programs for colleges and universities on how to deal with these issues so that students, faculty, staff and visitors can go about their business on campus in a safe environment without any additional concern. However, as noted from the literature search, there is little existing research on what these programs are comprised of and what their functions are. To most of the campus, these programs and the staff that maintain them are invisible. However, these programs are essential to the health and safety of the campus, including students, faculty, and staff. This study was designed to determine what exactly an EH&S program is and what effect it has on minimizing the number of risk of accidents and incidents to higher education institutions.

CHAPTER THREE

METHODOLOGY

There are few studies that have been done to explore what environmental health and safety (EH&S) programs are comprised of, how they are organized and structured, how they are staffed and funded, what role they play for research higher education institutions and what effect they have on risk of accidents and incidents to the institutions. The focus of this study was to conduct an exploratory study of EH&S programs and to identify key components in effective EH&S programs. This initial effort was followed by a determination of what constitutes an effective EH&S program by examining if EH&S components, organizational structure in terms of reporting levels and EH&S expenditures to determine effectiveness in terms of low risk of accidents and a low number of incidents. The third phase of the study was the development of model EH&S programs for various types of research colleges and universities based on student enrollment. The development of these models is intended to assist administrators and other professionals in assessing the effectiveness of their institutions' EH&S programs.

3.1 Research questions

This research was guided by the following questions:

- *What are the main components of an EH&S program, how are they staffed for research colleges and universities, and what effect do they have on the risk of accidents and incidents to the institution?*

- *Does the organizational structure of the EH&S program have an effect on the risk of accidents and incidents to the institution?*

- *To what degree does the expenditures of an EH&S program effect the risk of accidents and incidents to the institution?*

3.2 Population

For this study, all research colleges and universities in the *2008 The Campus Safety Health and Environmental Management Association* or CSHEMA Benchmarking Report represent the study's population of interest. CSHEMA is an association comprised of various colleges and universities whose focus is on addressing safety challenges. CSHEMA provides services to colleges, universities, and research communities by providing the latest news, information, and safety resources in the education and research communities to environmental health and safety professionals (CSHEMA, 2008).

Participants from 33 different states in the U.S. were represented. Table 3.1 displays states aligned with the corresponding number of institutions that participated in the 2008 CSHEMA Benchmark survey.

Table 3.1: State aligned with the corresponding number of institutions that participated in the 2008 CSHEMA Benchmark Report.

Number of institutions that participated in the 2008 CSHEMA Benchmarking Report	**State**
2	Arizona
1	Arkansas
14	California
2	Colorado
2	Connecticut
1	Delaware
1	Florida
3	Illinois
2	Indiana
2	Iowa
1	Kansas
3	Kentucky
1	Louisiana
3	Maryland
1	Michigan
4	Massachusetts
1	Minnesota
2	Missouri
1	Nebraska
2	New Hampshire
1	New Mexico
4	New York
3	North Carolina
3	Ohio
1	Oregon
5	Pennsylvania,
2	Tennessee
4	Texas
1	Utah
1	Virginia
2	Washington
1	West Virginia
1	Wisconsin
Total Institutions (N=78)	Total States (N=33)

3.3 Sample

The sample used was drawn from the 2008 CSHEMA Benchmarking Report. Of the 78 colleges and universities in the Benchmark report, the sample was limited to colleges and universities that conducted natural and/or physical science research, have an EH&S program, and have an enrollment greater than 5,000 students. Based on these criteria, the total number of CSHEMA institutions used in the study was 60. Of the 78 institutions, 18 were excluded from the study as they did not meet the qualification of being a research institution and/or did not have an enrollment greater than 5,000 students. Table 3.2 lists the number of sample institutions used for each of the institutions type from the 2008 CSHEMA Benchmark Report.

Table 3.2: Type of institutions based on the 2008 CSHEMA Benchmark Report for each of the student enrollment population size.

Type of institutions	**Student enrollment population size**	**Number of institutions from the 2008CSHEMA Benchmark Report**
Very Small Research University/College	Student enrollment less than 5,000	4 colleges and universities
Small Research University/College	Student enrollment between 5,001 to 12,000	6 colleges and universities
Research University/College	Student enrollment between 12,001 to 20,000	11 colleges and universities
Large Research University/College	Student enrollment greater than 20,000	39 colleges and universities

3.4 Instruments

The 2008 CSHEMA Benchmarking Survey Report was the instrument used for the study. CSHEMA has been conducting this benchmark survey with its members since 1995 (with a salary survey every alternate year) to help colleges and universities improve safety. Permission to use the 2008 CSHEMA Benchmarking Survey Report and the data contained in the report was granted prior to beginning the study (see Appendix A).

The survey attempts to measure EH&S operations for all member colleges and universities. The report compiles the data from the survey and measures institutions and their

EH&S functions against the total populations and against similar institutions. The report was compiled by *LTL Collaborative* who provided software program that utilized the internet to gather and process the data, and to ensure that the information collected was secured. In addition, *LTL Collaborative* organized the data and prepared the final report for CSHEMA.

3.4.1 Confidentiality assurance

Confidentiality was assured by CSHEMA for all institutions who participated in the 2008 CSHEMA Benchmark Report. Data was collected by creating an identification number for each participating institution. That identification number was used by participating institutions when they enter the CSHEMA website to answer the survey questions. In addition, during data collection, the 2008 CSHEMA Benchmarking survey activated different privacy and encryption settings to prevent the collection of any self identifying information and to prevent unauthorized access to the collected data. In the present study, there was no attempt to break the confidentiality of the CSHEMA data code. The results of the study only reflect institutions and the final model using anonymous identifiers.

3.4.2 Validation and reliability

Validity and reliability was carried out by CSHEMA and *LTL Collaborative*. Increased validity and reliability helped ensure a stronger study and ensured that results were more applicable to the entire population. The survey question designs for the 2008 CSHEMA Benchmarking Report were written in early 1995 by CSHEMA's Research and Information Committee (RSIC). The survey instrument questions were written in clear language with appropriate sentence structure and readability. The questions were then reviewed by focus groups consisting of RSIC and an advisory group of additional CSHEMA members representing a wide range of colleges and universities who offered feedback on the drafts of the survey to ensure content validity. Content validity was further measured by modeling questions from previous self reporting CSHEMA surveys. The survey make up or construct validity was aided by grounding similar survey instrument questions from prior Benchmark Report studies into the 2008 CSHEMA Benchmarking Survey as well.

For the validation report, the data was scanned for errors by singling out the outlying statistics. For the 2008 CSHEMA Benchmarking Report, the highest and lowest calculations that appeared to be unreasonable were questioned. If a data point appeared to be erroneous and verification could not be gained by the underlying figures from the institution, the data point was removed. Some data points were correct but are not comparable because of unique institution circumstances. These were left in the data pool but are not included in statistical summaries (CSHEMA, 2008).

Reliability was determined by examining the internal consistency of responses to different items measuring the same construct. The data was reviewed in a number of ways. The "raw" numbers were scanned to see if they fell within reasonable boundaries. When all of the surveys were received multiple editing reports were run. The editing reports were designed to discover numbers that may be error by looking at ratios such as, the ratio of faculty to students and faculty to staff. Then the benchmarks were calculated and the scores in the low and high extremes were scrutinized (CSHEMA, 2008).

3.5 Variables

The information for the variables used in this study was obtained from in the 2008 CSHEMA data and included: overall EH&S program composition such as chemical, biological, radioactive and other health and safety components; number of EH&S program staff; EH&S program organizational structure and number of reporting levels; budget and salary; institutional cohort groupings; enrollment data; institution expenditures; the numbers of reported injuries and illnesses; lost workdays; and the number of audits and violations from federal, state, and local authorities.

3.5.1 Operational Definitions

The study utilized the following operational definitions for the variables used in this study.

Independent variables

EH&S program components - included the number of EH&S components in an all-inclusive EH&S program and their related number of full-time equivalent (FTE) staff for the biological safety; chemical safety; radiation safety; laboratory safety; building code/life safety; fire safety; risk management, industrial hygiene, and emergency management. This variable is used to answer the first research question, "*What are the main components of an EH&S program, how are they staffed for research colleges and universities, and what effect do they have on the risk of accidents and incidents to the institution?*" To determine effectiveness, this variable is utilized by combining the number of FTE staff for all of the components.

EH&S component reporting levels – This variable measured the number of reporting levels within the individual EH&S components that would report to a President or the Vice President of the institution's higher administration. This variable was used to answer the second research question, "*Does the organizational structure of the EH&S program have an effect on the risk of accidents and incidents to the institution?*"

EH&S program expenditures - This variable measured expenditures for each of the components, including budget and salary. This variable is used to answer the third research question, "*To what degree does the expenditures of an EH&S program effect the number of risk of accidents and incidents to the institution?*" As a measure of effectiveness, this variable combines the expenditures for all of the components.

Dependent variables

These dependent variables are the same for all three research questions. The outcomes of these variables are determined by: the number of FTE staff for all of the components in an EH&S program, the number of reporting levels for each component in an EH&S program, and the expenditures for all components.

The numbers of reported injuries and illnesses - This variable measured the number of reported injuries and illnesses to determine effectiveness or lack of effectiveness of the EH&S programs at the institutions in terms of risk of accidents and incidents.

The numbers of lost workdays - This variable measured the numbers of lost workdays to the institutions to determine effectiveness of EH&S programs in terms of institution's risks of accidents and incidents.

The number of audits and violations from federal, state, and local authorities - This variable measured the numbers of audits and violations to determine effectiveness of EH&S programs in terms of institution's risks of accidents and incidents.

Table 3.3 provides the coding details for the independent and dependent variables which were used in the data analyses.

Table 3.3: Description of variables.

Variables	Type of Variables	Descriptions
EH&S program components and number of FTE	Independent Variable	
biological safety	Continuous	Scores from the 2008 CSHEMA Benchmark
chemical safety	Continuous	Scores from the 2008 CSHEMA Benchmark
radiation safety	Continuous	Scores from the 2008 CSHEMA Benchmark
laboratory safety	Continuous	Scores from the 2008 CSHEMA Benchmark
fire safety	Continuous	Scores from the 2008 CSHEMA Benchmark
risk management	Continuous	Scores from the 2008 CSHEMA Benchmark
industrial hygiene	Continuous	Scores from the 2008 CSHEMA Benchmark
emergency management	Continuous	Scores from the 2008 CSHEMA Benchmark
EH&S component reporting levels	Independent Variable	
biological safety	Continuous	Scores from the 2008 CSHEMA Benchmark
chemical safety	Continuous	Scores from the 2008 CSHEMA Benchmark
radiation safety	Continuous	Scores from the 2008 CSHEMA Benchmark
laboratory safety	Continuous	Scores from the 2008 CSHEMA Benchmark
fire safety	Continuous	Scores from the 2008 CSHEMA Benchmark
risk management	Continuous	Scores from the 2008 CSHEMA Benchmark
industrial hygiene	Continuous	Scores from the 2008 CSHEMA Benchmark
emergency management	Continuous	Scores from the 2008 CSHEMA Benchmark
EH&S program expenditures	Independent Variable	
biological safety	Continuous	Scores from the 2008 CSHEMA Benchmark
chemical safety	Continuous	Scores from the 2008 CSHEMA Benchmark
radiation safety	Continuous	Scores from the 2008 CSHEMA Benchmark
laboratory safety	Continuous	Scores from the 2008 CSHEMA Benchmark
fire safety	Continuous	Scores from the 2008 CSHEMA Benchmark
risk management	Continuous	Scores from the 2008 CSHEMA Benchmark
industrial hygiene	Continuous	Scores from the 2008 CSHEMA Benchmark
emergency management	Continuous	Scores from the 2008 CSHEMA Benchmark
The numbers of reported injuries and illnesses	Dependant Variable	
	Continuous	Scores from the 2008 CSHEMA Benchmark
The numbers of lost workdays	Dependant Variable	
	Continuous	Scores from the 2008 CSHEMA Benchmark
The number of audits and violations from federal, state, and local authorities	Dependant Variable	
	Continuous	Scores from the 2008 CSHEMA Benchmark

3.6 Design and procedures

3.6.1 Phase one: Identifying key elements of an EH&S program

Phase one was an exploratory study that identified key components of an all-inclusive EH&S program and what function these components have for the various institutions types in terms of student enrollment size. For this phase of the study, a literature search of scholarly journals, federal, state, and local regulating entities as well as professional organizations relating to health and safety in higher education institutions was conducted to determine the major components of an all-inclusive EH&S program, in addition to the elements used in the CSHEMA report. Much of the literature reviewed is cited in Chapter 2.

Searches of the literature found that a limited number of reference materials were available for all-inclusive EH&S programs in higher education institutions. Since there was little current literature on all-inclusive safety programs in higher education institutions, this study used the established work by Carsey and Hunt (1983) as a foundation to determine key components of an EH&S program. From this groundwork, a more in-depth literature search on the individual components of EH&S program was conducted to determine what function they play for the institution.

3.6.2 Phase two: Identifying effectiveness of EH&S programs

The second phase of the study looked at the effectiveness of EH&S programs for the various institutions type in terms of student enrollment size. Since there are limited references materials pertaining to the effectiveness of an all-inclusive EH&S programs in higher education institutions, this phase of the study used what was learned from phase one in terms of the makeup of an EH&S programs, how they are organized and structured, how they are staffed and their expenditures . To determine what significant effect these components have on the risk of accidents and incidents, the study utilized a multiple regression analysis using the 2008 CSHEMA Benchmarking data to address each of the three research questions. The independent and dependent variables used for the multiple regression analysis are identified in the variable section of this chapter. Appendix B provides a directory of the 2008 CSHEMA Benchmark instrument items used to gather the data. Table 3.4 lists the 2008 CSHEMA Benchmark instrument items that were used to answer the three research questions as they relate to EH&S programs' effectiveness on the risk of accidents and incidents.

Table 3.4: Applicable questions selected from CSHEMA Benchmark instrument questions.

Question	**Research Question**	**Applicable selected CSHEMA Benchmark instrument questions**
RQ1	*What are the main components of an EH&S program, how are they staffed for research colleges and universities, and what effect do they have on the risk of accidents and incidents to the institution?*	IP 1.0, IP 1.1, IP 1.2, IP 1.5, IP 1.6, IP 1.7 to IP 1.16, GS 2.1, GS 2.2 RC 5.1a, RC 5.1b, RC 5.1c, RC 5.1d WS 6.2, WS 6.4, WS 6.6, 10.1.1 through 10.37.3
RQ2	*Does the organizational structure of the EH&S program have an effect on the risk of accidents and incidents to the institution?*	IP 1.19, IP 1.20, IP 1.21 GS 2.1, GS 2.2 FS 3.1 BS 4.1, BS 4.2, RC 5.1a, RC 5.1b, RC 5.1c, RC 5.1d RS 7.1
RQ3	*To what degree does the expenditures of an EH&S program effect the number of risk of accidents and incidents to the institution?*	IP 1.20, IP 1.21, IP 1.22, IP 1.23, IP 1.3, IP 1.4 GS 2.1, GS 2.2 RC 5.1a, RC 5.1b, RC 5.1c, RC 5.1d WS 6.2, WS 6.4, WS 6.6, 10.1.1 through 10.37.3

Note: BS = Biological Safety, FS = Fire Safety, GS = General Safety, IP = Institutional Profile, RS = Radiation Safety, RC = Regulatory Compliance, WS = Waste Disposal

EH&S programs for the types of research higher education institutions were then compared to each other to determine their overall effectiveness on the risk of accidents and incidents for the institution.

Following this evaluation, the third phase of the study was the development of model EH&S programs for each of the research higher education institution types.

3.6.3 Phase three: Developing a model EH&S program

For model development, the CSHEMA 2008 Benchmark Report, as well as the related literature, served as the data source for this phase of the study. The 2008 CSHEMA

Benchmarking Report was used to identify the types of research institutions, based on student enrollment population. Utilizing the findings from phase one, key aspects of the model were built around items such as: what specific EH&S program components, e.g. chemical, biological, and other major components of an EH&S program are housed within the institution; the number of reporting levels to higher administration; total EH&S expenditures; and program staffing. The result of multiple regressions analysis from the three research questions in phase two was used to determine effectiveness for each type of research institution EH&S program model.

Figure 3.1 illustrates the three phases of the study on EH&S program for research higher education institutions and, in particular, how the 2008 CSHEMA Benchmarking Report data was used for the development of the model.

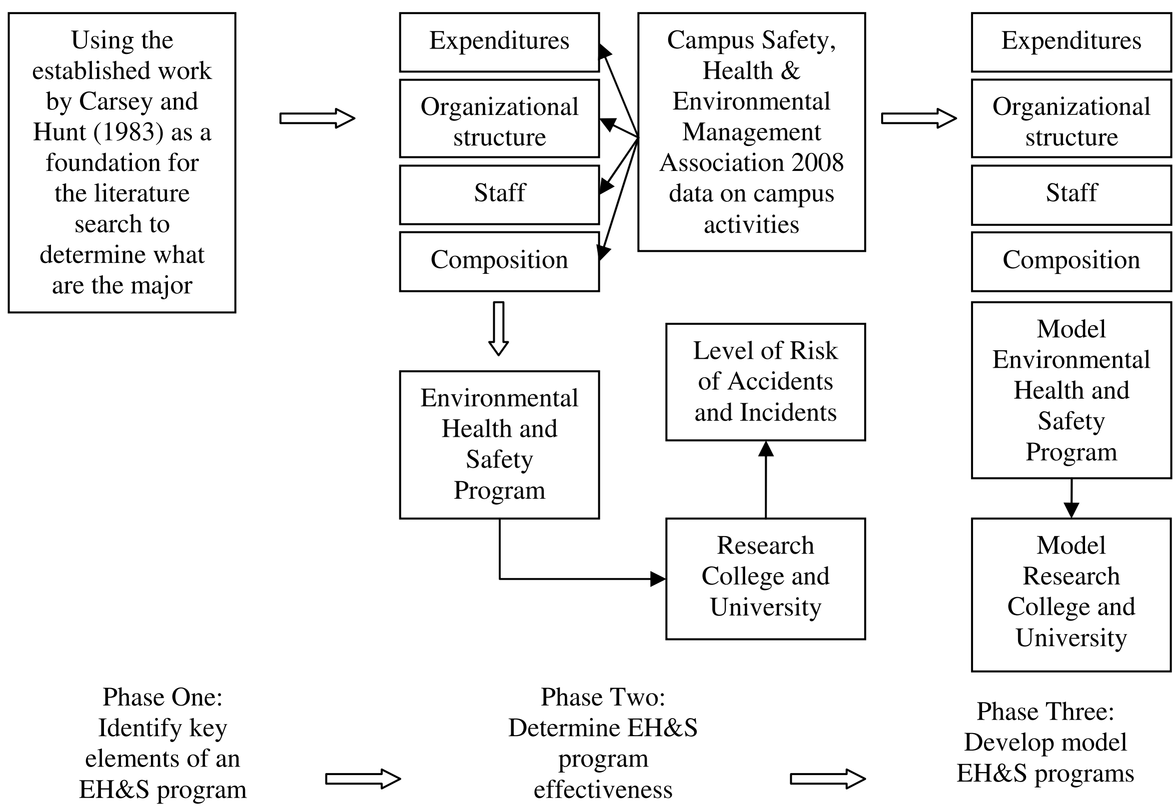

Figure 3.1: The three phases of the study.

3.8 Data analysis

Descriptive and inferential statistics were utilized for the data analysis. Descriptive statistics were used to provide an initial sorting of the CSHEMA data to answer the research questions. Frequency tables were used to classify the data as were frequency summaries. Frequency tables were used to provide a summary view of how different values were distributed in the sample. These frequency distributions also provided a descriptive view of the data. The frequency distribution information was presented as percentages and means. A comparison of percentages and means for each of the key variables was also employed.

To explore the data in greater depth and to answer the three research questions, inferential statistics were employed using SPSS statistical software analysis. In this study, multiple regressions were conducted to interpret the data. Regression analysis was conducted to estimate the relationships between the variables in the exploratory study phase and the EH&S model development phase. Regression analysis was useful in investigating the EH&S program composition, how the programs are organized and structured, how they are staffed and funded, and the effect of these characteristics on the institution's risk of accidents and incidents.

For the first research question, "*What are the main components of an EH&S program, how are they staffed for research colleges and universities, and what effect do they have on the risk of accidents and incidents to the institution?"*, to determine effectiveness, for the various institutions type in terms of student enrollment size, the study regressed the number of injuries and illnesses; the number of lost workdays; and the number of audits and violations (the dependent variables), with the number of FTEs (the independent variable).

For the second research question, *"Does the organizational structure of the EH&S program have an effect on the risk of accidents and incidents to the institution?"*, the study regressed the number of injuries and illnesses; the number of lost workdays; and the number of audits and violations (the dependent variables) with EH&S organizational structure, specifically number of reporting levels (the independent variable) for the various institutions type in terms of student enrollment size.

For the final research question, *"To what degree does the expenditures of an EH&S program effect the number of risk of accidents and incidents to the institution?*, the study regressed the number of injuries and illnesses; the number of lost workdays; and the number of audits and violations (the dependent variables) with the EH&S program expenditures (the independent variable) for the various institutions type in terms of student enrollment size.

The results from the data analysis defined, identified, and characterized the makeup of an all-inclusive EH&S program for the various research higher education institutions type in terms of student enrollment size. Additionally, the results allowed the researcher to assess what common components are associated with EH&S programs. Furthermore, the results enabled the researcher to determine what significance EH&S programs have on the risk of accidents and incidents to an institution. These results were then used in the development of model all-inclusive EH&S programs for the various types research colleges and universities.

3.9 Summary

Most colleges and universities engaged in an active research program in the United States have an all-inclusive EH&S program; yet there are few, if any, studies that examine and explore what these programs are comprised of, what role they play for higher education institutions and what effect they have on minimizing the number of risk of accidents and incidents to the institution. This study was able to extract common characteristics of EH&S programs to determine what their functions are and how they are engaged with higher education institutions.

This chapter provided details on how the study was carried out by outlining the population and the samples used, the instruments used to collect the data, defining the variables used, providing the design and procedures and the data analysis that was carried out for study.

To the degree possible, this study increase the awareness of the need for and importance of all-inclusive EH&S programs in higher education on campuses where an active research program occurs by providing a better understanding of what effect EH&S programs have on the risk of accidents and incidents to institutions. On any campus, some level of EH&S should be in place to prepare for and prevent accidents and to respond to the unexpected, including weather related or, unfortunately as seen of late, dangers to the campus from students or others who seek to do harm to others. Overall, it is a goal of this study to provide higher education administration professionals with a better understanding of the EH&S program within their institutions.

CHAPTER FOUR

FINDINGS

4.1 Overview

The organization structure for this chapter consists of:

- A reintroduction of the conceptual framework outlined in chapter one.

  This is to reintroduce the three phases of the study in a graphical display.

- A summary of the final sample.

  This section outlines the final sample used from 2008 *The Campus Safety Health and Environmental Management Association,* or CSHEMA, Benchmarking Report.

- The findings for the three research questions.

  This section presents the finding for the three research question that were set forth in chapter one. Findings for the questions are examined by using the statistical analysis techniques outlined in chapter three. Findings for each of the three research questions are summarized with descriptive data summaries and simple crosstabs and analyzed using multiple regressions.

- Model development of EH&S program.

  From the summary and findings, the study developed all-inclusive EH&S program models for research colleges and universities based on student enrollment population size.

- Comparison of the various all-inclusive EH&S models

  This chapter concludes with a comparison of the models of the all-inclusive EH&S programs for the different types of higher education institutions.

4.2 Reintroduction of the Conceptual Framework

The first phase of the study utilized an exploratory study to determine the various types of EH&S programs composition, and how EH&S programs are organized and structured. The second phase of the study examined: EH&S staff, organization level, and expenditures to determine what effect they have on the risk of accidents and incidents to the research institution. Following the exploratory study, the third phase of the study consisted of the development of EH&S program models for research higher education institutions, based on student enrollment population sizes. The conceptual research design is graphically displayed in figure 4.1.

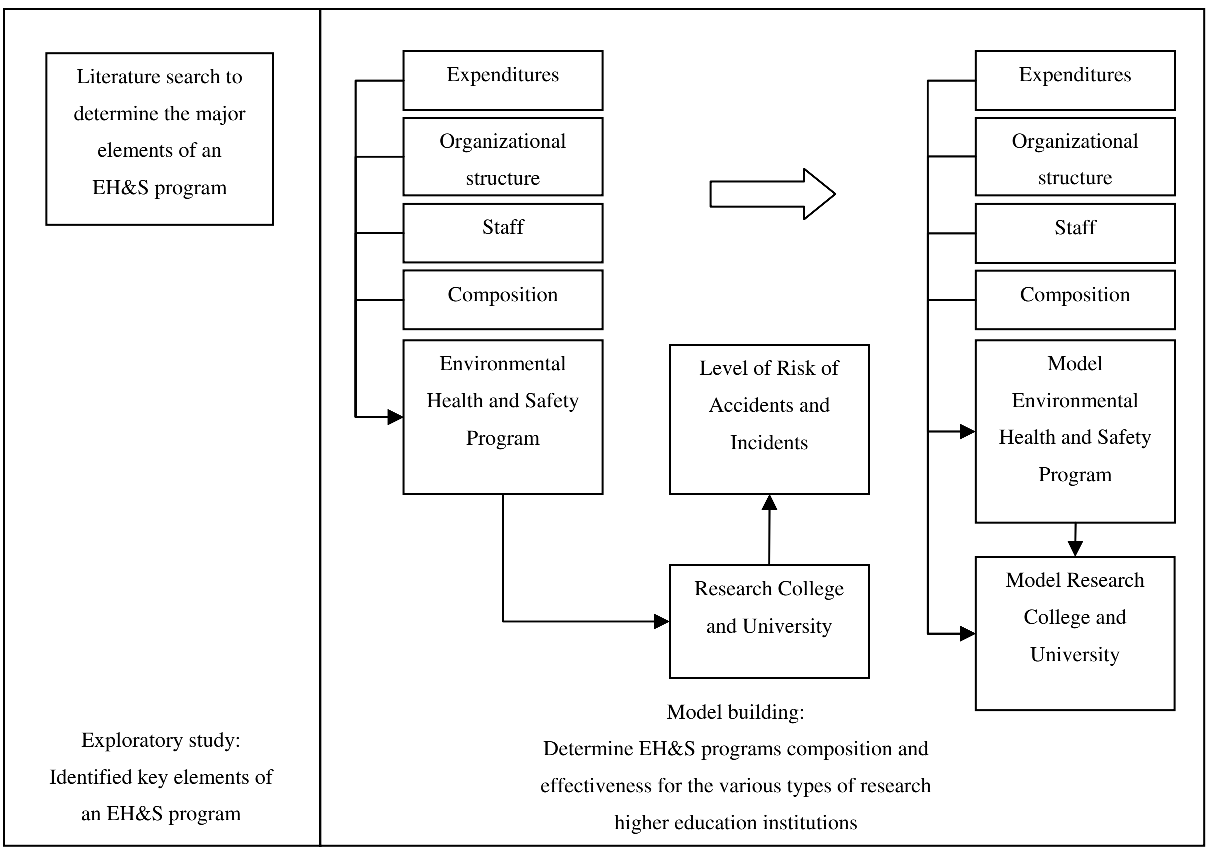

Figure 4.1: Reintroduction of the conceptual framework of the research design.

4.3 Sample used

The sample used was selected from the 2008 CSHEMA Benchmarking Report. Of the 78 colleges and universities that participated in the Benchmark Report, the sample was limited to colleges and universities that have an EH&S program, a student enrollment greater than 5,000, and conduct natural and/or physical science research. Based on these initial criteria, the total number of institutions used in the study was initially set at 60. Of the 78 institutions, 18 were not used in the study because they did not meet the qualification of being a research institution and/or did not have a student enrollment greater than 5,000. The rationale for excluding these 18 institutions included their lack of research and a lack of activity in the significant research areas. This lack of activity would have confounded the results. It was determined that institutions with lower enrollments were much more likely have a level of institutional research activity which in turn required little or no EH&S program oversight.

Finally, upon further review, of the remaining 60 institutions, two more institutions were eliminated. One institution was excluded because the institution did not provide any data benchmarking survey. A second institution was eliminated because it reported less than 50% of the data requested on the benchmarking survey. These institutions were included in the CHSHEMA report but were not included in the sample. These changes left a total of 58 institutions in the sample.

4.3.1 Summary of the type of institutions

Institutional types were collapsed from four categories to two for ease of clarification between the types of institutions used in the study. Institutions identified by the 2008 CHEMA Benchmarking Report were Very Small Research University/College with student enrollment less than 5,000; Small Research University/College with student enrollment between 5,001 to 12,000; Research University/College with student enrollment between 12,001 to 20,000; and Large Research University/College with student enrollment greater than 20,000. For the purposes of this study, these institution types were collapsed to Small and Large institutions. Small institutions were defined as Research Universities/Colleges with student enrollment less than 20,000 and Large institutions defined as Research Universities/Colleges with student enrollment greater than 20,000.

Therefore, the sample used in the data analysis consisted of 19 (32.76%) Research Universities/Colleges with student enrollment less than 20,000; and 39 (50.00%) Research Universities/Colleges with student enrollment greater than 20,000. A total of 58 (74.36%) institutions from the 2008 CSHEMA Benchmarking Report were used out of the original 78 institutions. Table 4.1 is a comparison of the initial and final number of institutions that were used for each of the institution types from the 2008 CSHEMA Benchmark Report.

Table 4.1: Crosstab comparison of initial and final number of institutions types used from the 2008 CSHEMA Benchmarking Report.

Type of institutions	**Student enrollment population size**	**Number of institutions from the 2008CSHEMA Benchmark Report**	**%**	
Very Small Research University/College	Student enrollment less than 5,000	4 colleges and universities	5.13 %	
Small Research University/College	Student enrollment between 5,001 to 12,000	6 colleges and universities	7.69%	**Initial**
Research University/College	Student enrollment between 12,001 to 20,000	11 colleges and universities	14.10%	
Large Research University/College	Student enrollment greater than 20,000	39 colleges and universities	50.00%	
Total (N=78)		60	76.92%	
Small institutions (Enrollment < 20K)	Student enrollment less than 20,000	19 colleges and universities	32.76%	**Revised**
Large institutions (Enrollment > 20K)	Student enrollment greater than 20,000	39 colleges and universities	50.00%	
Total (N=78)		58	74.36%	

From the 58 sample institutions used in the study, the mean student enrollment for the institutions with student enrollment less than 20,000 was 11,179. For institutions with student enrollment greater than 20,000, the mean student enrollment was 32,098.

In addition to providing oversight for student safety programs, EH&S programs also provide oversight to faculty, staff, and visitors. For institutions with student enrollment less than 20,000, the number of faculty and staff mean was 5,197, and the number of student, faculty and staff combined mean was 16,387. For institutions with student enrollment greater than 20,000, the mean number of faculty and staff was 10,276, and the mean number of student, faculty and staff combined was 42,406. Table 4.2 lists the mean student enrollment, the mean number of faculty and staff, and the mean number of student, faculty and staff for the two types of institutions. From an EH&S perspective, the important issue is how many people populate the campus as this number affects any and all concerns related to environment, health, and safety at any given moment.

Table 4.2: Means for student enrollment, faculty and staff, and combined student, faculty and staff from the 2008 CSHEMA Benchmark Report.

Type of institutions	**Mean student FTE enrollment**	**Mean number of faculty and staff FTE**	**Mean number of students, faculty and staff FTE**
Small institutions (Enrollment < 20K)	11,179 (N=19)	5,197 (N=19)	16,387 (N=19)
Large institutions (Enrollment > 20K)	32,098 (N=39)	10,276 (N=39)	42,406 (N=39)

4.3.2 Summary of the number of risk of accidents and incidents to the institutions

For this study, The three dependent variables for the three research questions were defined in terms the of the risk of accidents and incidents to the institutions, where risk of accidents and incidents are classified as number of reported injuries and illnesses, number of lost workdays, and the number of audits and citations from federal, state, and local authorities. For institutions with student enrollment less than 20,000, the mean number of reported injuries and illnesses was 257; the mean number of lost workdays was 2,233; and the mean number of audits and citations was 37. For institutions with student enrollment greater than 20,000, the mean number of reported injuries and illnesses was 351; the mean number of lost workdays was 2,466; and the mean number of audits and citations was 13. Table 4.3 lists means for reported injuries and illnesses, lost workdays, and audits and citations for the two institution types.

Table 4.3: Mean number of reported injuries and illnesses, mean number of lost workdays, and mean number of audits and citations.

Type of institutions	Reported injuries and illnesses mean	Mean number for lost workdays	Mean number for audits and citations
Small institutions (Enrollment < 20K)	257 (N=19)	2,233 (N=19)	37 (N=19)
Large institutions (Enrollment > 20K)	351 (N=36)	2,466 (N=35)	13 (N=39)

4.4 Findings for the research questions

No other studies reviewed in the literature have examined what effect EH&S program components, organizational structure of the EH&S programs, and expenditures by EH&S programs have on the risk of accidents and incidents to colleges and universities. This study provides a foundation for the study of an all-inclusive EH&S program by contributing to the existing literature on EH&S programs. Findings from this study are meant to aid higher education administrators in their approach to improve their institution's safety programs.

The research questions that directed the study are as follows:

- *What are the main components of an EH&S program, how are they staffed for research colleges and universities, and what effect do they have on the risk of accidents and incidents to the institution?*

- *Does the organizational structure of the EH&S program have an effect on the risk of accidents and incidents to the institution?*

- *To what degree does the expenditures of an EH&S program effect the number of risk of accidents and incidents to the institution?*

To determine the relationship between the variables as represented in the conceptual model, multiple regression analysis was completed to address each of the research questions. Results are discussed in the following sections and are also graphically displayed in tables for each of the questions.

4.4.1 Findings for Research question 1

What are the main components of an EH&S program, how are they staffed for research colleges and universities, and what effect do they have on the risk of accidents and incidents to the institution? To address the first research question, information was collected on EH&S programs for universities and colleges from across the U.S. This information took the form of a literature search dating back to the 1970s that included federal, state, and local regulating entities as well as professional organizations related to health and safety in higher education institutions. The literature search determined that the difficulty with a study of this type is that higher education institutions must deal with a wide variety of environmental health and safety concerns which are often presented as individual components that are specific to their areas of specialty. These areas of specialty include such diverse areas as radioactive materials use and machine producing radiation regulations; biological materials use and security regulations; chemical use and disposal regulations, and so on.

<u>Main components and staff numbers for an EH&S program</u>

As a result of this finding, the study narrowed the focus of the research by using the established work by Carsey and Hunt (1983) as a foundation to establish what components need to be included in the study of all-inclusive EH&S programs. By building Carsey and Hunt, it was determined that there are eight primary components in an all-inclusive EH&S program. The components are: biological safety, chemical safety, radiation safety, laboratory safety, fire safety, risk management, industrial hygiene/ occupational health, and emergency management. From an analysis of the 2008 CSHEMA Benchmarking Report for the types of higher education institutions, it was determined that all eight components were present in the study and could be considered the main components of an all-inclusive EH&S program. This finding was evident through the number of full-time equivalent (FTE) staff for each of the components as outlined in the 2008 CSHEMA Benchmarking Report. Table 4.4: Lists the mean FTE for each of the EH&S components for the two institution types.

Table 4.4: Mean FTE for each of the EH&S components.

Type of Components	Small institutions (Enrollment < 20K)	Large institutions (Enrollment > 20K)
Biological safety mean FTE	2.0 (N=17)	2.3 (N=38)
Chemical safety mean FTE	2.7 (N=19)	2.5 (N=37)
Radiation safety mean FTE	4.0 (N=18)	4.9 (N=38)
Industrial hygiene/ occupational health mean FTE	1.7 (N=14)	2.3 (N=28)
Laboratory safety mean FTE	2.2 (N=18)	3.8 (N=37)
Fire safety mean FTE	3.6 (N=19)	4.9 (N=34)
Risk management mean FTE	3.1 (N=19)	4.6 (N=37)
Emergency management mean FTE	1.5 (N=13)	1.3 (N=25)
mean Total EH&S FTE	19.6 (N=19)	24.0 (N=39)

In addition, among the two types of research higher education institutions examined in the study, the total mean EH&S FTE staff for an all-inclusive EH&S program was slightly larger for research higher education institutions that have student enrollment greater than 20,000 as compared to institutions with student enrollment less than 20,000. The ratio between EH&S FTE staff per 1,000 students, faculty, and staff was also smaller for research higher education institutions that have student enrollment greater than 20,000 as compared to institutions with student enrollments less than 20,000. The mean EH&S FTE staff, and the ratio of the mean EH&S FTE staff per 1,000 students, faculty and staff are listed in Table 4.5.

Table 4.5: Mean EH&S FTE staff and the mean EH&S FTE staff per 1,000 student, faculty, and staff.

Type of institutions	Mean EH&S FTE staff	Mean EH&S FTE staff per 1,000 students faculty and staff
Small institutions (Enrollment < 20K)	19.6 (N=19)	1.4 (N=19)
Large institutions (Enrollment > 20K)	24 (N=39)	0.6 (N=39)

<u>EH&S FTEs effect on the institution's risk of accidents</u>

To answer the first research question, number of reported injuries and illnesses, number of lost workdays and the number of audits and citations from federal, state, and local authorities (the dependant variables), were regressed with the total number of EH&S FTEs for the eight components (the independent variables) for each of the two institution types.

EH&S FTEs effect on the institution's reported injuries and illnesses

For both type of research institutions, when number of reported injuries and illnesses (the dependant variable), was regressed with the total number of EH&S FTEs (the independent variable), the results from the multiple regression analysis determined for research institutions with student enrollment less than 20,000, the p value was < 0.001 and the beta coefficient was 0.740. For research institutions with student enrollment greater than 20,000, the p value was < 0.001, and the beta coefficient was 0.552. This analysis indicated that the variable, EH&S FTE was significant and a good model for predicting reported injuries and illnesses for both types of research institutions.

For research institutions with student enrollment less than 20,000, the multiple regressions yielded that for institutions to be effective, one EH&S FTE would prevent 10.125, or ~10, reported injuries and illnesses. With the R^2 value of 0.522 indicating that 52.2% of the variance in reported injuries and illnesses was explained by the regression model.

For research institutions with student enrollment greater than 20,000, the results from the multiple regression analysis indicated that to be effective, the institutions would need one EH&S FTE in order to prevent 11.579, or ~12, reported injuries and illnesses,. For this institution type, 28.4% of the variance in reported injuries and illnesses was explained by the regression model.

Table 4.6 provides details of the multiple regression analysis coefficients for the types of institutions in terms of total EH&S FTE and the number of reported injuries and illnesses.

Table 4.6: The relationship between the total EH&S FTE staff and the number of reported injuries and illnesses.

Coefficients[a]

Model	B	SEB	β	Sig.
1. Small institutions (Enrollment < 20K) Total EH&S FTEs	10.125	2.229	.740	.000
2. Large institutions (Enrollment > 20K) Total EH&S FTEs	11.579	3.001	.552	.000

a. Dependent variable: Reported Injuries and Illnesses
R^2 = 0.522 (Model 1); R^2 = 0.284 (Model 2)

EH&S FTE effect on the institution's numbers of lost workdays

When number of lost workdays (the dependent variable), was regressed with the total number of EH&S FTEs (the independent variable), for both type of research institutions, the results from the multiple regression analysis indicated that for both types of institutions, total number of EH&S FTE staff were significant and acceptable regression models for predicting number of reported lost workdays. For research institutions with student enrollment less than 20,000, the p value was < 0.029 and the beta coefficient was -0.515. For research institutions with student enrollment greater than 20,000, the p value was < 0.001 and the beta coefficient was -0.557.

For research institutions with student enrollment of less than 20,000, the results from the regression analysis indicated that for every 96.535, or~ 97, lost workdays, the institutions would need one EH&S FTE to be effective. In other words, for every one EH&S staff member, the institution could prevent ~97 lost work days. For this institution type, the R^2 value of 0.22 indicated 22% of the variance in the number of lost workdays was explained by the model.

For research institutions with student enrollment greater than 20,000 the multiple regressions yielded that for every 102.747,or ~103, number of lost workdays, the institutions would need one EH&S FTE in order to be effective. In other words, for every one EH&S staff, the institution could prevent ~103 lost work days. 29% of the variance in the numbers of lost workdays was explained by the model.

Table 4.7 provides details of the multiple regression analysis coefficients for the types of institutions in terms of number of total EH&S FTE staff and numbers of lost workdays.

Table 4.7: The relationship between the total EH&S FTE staff and the number of lost workdays.

Coefficients[a]

Model	**B**	**SEB**	**β**	**Sig.**
1. Small institutions (Enrollment < 20K)				
Total EH&S FTEs	-96.535	40.135	-.515	.029
2. Large institutions (Enrollment > 20K)				
Total EH&S FTEs	-102.747	26.650	-.557	.001

a. Dependent variable: Lost Workdays
R^2 = 0.220 (Model 1); R^2 = 0.290 (Model 2)

EH&S total FTEs effect on the institution's number of audits, and citations

When the dependent variable, number of audits, and citations for the institutions, was regressed with the total number of EH&S FTEs (the independent variable); for research institutions with student enrollment less than 20,000 the regression analysis determined the p value was < 0.008 and the beta coefficient was 0.592 which indicated the total number of EH&S FTE staff was significant. The analysis also indicated that for every 3.465, or ~3, audits, and citations, the institutions would need one EH&S FTE to be effective. Put another way, for every one EH&S staff, the institution could prevent ~3, audits, and citations. With the R^2 value of 0.312 indicating that 31.2% of the variance in the number of audits, and citations was explained by the model. However, for research institutions with student enrollment greater than 20,000, the regression analysis did not yield a significant finding. Table 4.8 provides details of the multiple regression analysis coefficients for the types of institutions in terms of total number of Total EH&S FTE staff number and the number of audits and citations to the institutions.

Table 4.8: The relationship between the total EH&S FTE staff and the number of audits, and citations.

Coefficients[a]

Model	**B**	**SEB**	**β**	**Sig.**
1. Small institutions (Enrollment < 20K) Total EH&S FTEs	3.465	1.145	.592	.008

a. Dependent variable: Federal, state and local compliance inspections
R^2 = 0.312 (Model 1)

Summary of findings for the Research question 1

To summarize, the findings for the first research question, the ratio between FTE EH&S staff per 1,000 student, faculty, and staff was smaller for research higher education institutions that have student enrollment greater than 20,000 when compared to research higher education institutions that have student enrollment less than 20,000.

For both types of research higher education institutions, number of EH&S FTE staff was significant in predicting the number of reported injuries and illnesses and the number of lost work days.

In predicting effectiveness in terms of the number of audits and citations; institutions with student enrollment of less than 20,000, the number of EH&S FTE staff was significant in predicting effectiveness. However, for research institutions with student enrollment greater than 20,000, the total number of EH&S FTE had no significance in predicting effectiveness in terms of the number of audits, and citations incurred by the institutions.

4.4.2 Findings for Research question 2

Does the organizational structure of the EH&S program have an effect on the risk of accidents and incidents to the institution? To answer the second research question, this phase of the study examined the organizational structure of EH&S programs. This phase of the study used what was learned from question one and focused on the main components of an all-inclusive EH&S program to determine how these components are organized and structured. This phase of the study also utilized the 2008 CSHEMA Benchmarking data.

<u>Organizational structures for an all-inclusive EH&S program</u>

The study found that by examining the 2008 CSHEMA Benchmarking data, there were two types of organizational structures for an all-inclusive EH&S program. The first type was a centralized EH&S program, where all the components are within a dedicated EH&S program that was contained either as a department or division. In this organizational structure, each component reports to an EH&S department head, who in turn reports to the President or the Vice President within the institution's higher administration. The study found that for this type of organizational structure, there are multiple reporting levels within the individual EH&S components as well. In addition, the study found that this type of organizational structure was more representative of organizational structures for existing EH&S programs. The second type of organizational structure for an EH&S program was a fragmented structure in which components are uncoupled from one another and report to a President or the Vice President of the institution's higher administration directly and separately. Types of institutions and their associated organizational structure are outlined in Table 4.9.

Table 4.9: Types of institutions and their associated organizational structure.

Type of institutions	Centralized EH&S organizational structure	%	Fragmented EH&S organizational structure	%
Small institutions (Enrollment < 20K)	11	18.97%	8	13.79%
Large institutions (Enrollment > 20K)	28	48.28%	11	18.97%
Total institutions (N=58)	39	67.24%	19	32.76%

<u>EH&S organizational structures effect on the institution's risk of accidents</u>

To address the second research question, the number of reported injuries and illnesses; number of lost workdays; and the number of audits, and citations from federal, state, and local authorities (the dependent variable) were regressed with the type of organizational structure in terms of EH&S reporting levels (the independent variable) for the two types of institutions.

EH&S organizational reporting structures effect on the institution's numbers of reported injuries and illnesses

For both types of institutions, the results from the multiple regression analysis found that number of EH&S reporting levels (the independent variable) had no significant results in predicting the effectiveness in terms of numbers of reported injuries and illnesses (the dependent variable) to the institutions.

EH&S organizational reporting structures effect on the institution's number of lost workdays

For both types of institutions, the results from the multiple regression analysis found that the number of EH&S reporting levels (the independent variable) had no significant results in predicting effectiveness to the institutions in terms of numbers of lost workdays (the dependent variable).

EH&S organizational reporting structures effect on the institution's number of audits, and citations

For both types of institutions, the results from the multiple regression analysis found that the number of EH&S reporting levels (the independent variable) had no significance in predicting effectiveness to the institutions in terms of numbers of audits and citations (the dependent variable).

<u>Summary of the finding for the second research question</u>

To summarize the findings for the second research question, the study found that there are two types of organizational structures for an all-inclusive EH&S program. The first type was a centralized EH&S program, where all the components are within a dedicated EH&S program with multiple reporting levels within the EH&S program reporting to the program director who in turn would report to institution's higher administration. The second type of organizational structure was a fragmented structure where the EH&S components are uncoupled from one another and report to the institution's higher administration directly and separately. A centralized organizational reporting structure was more representative for EH&S programs in this study.

The study found that the EH&S reporting levels to the institution's higher administration was not significant in determining effectiveness in terms of the number of risk of accidents and incidents to the institutions as defined by the number of injuries and illness, number of lost work day, and number of audits and citations.

4.4.3 Findings for Research question 3

To what degree does the expenditures of an EH&S program effect the number of risk of accidents and incidents to the institution? For the answer to the third research question, this phase of the study examined data from the 2008 CSHEMA Benchmarking Report.

<u>EH&S program expenditures</u>

The study found that by analyzing the 2008 CSHEMA Benchmarking data for both types of research institutions, the mean for EH&S program expenditures; and mean total EH&S

program expenditures per $1 million ($1M) campus expenditures were even. The study also found that EH&S program expenditures per student, faculty and staff FTEs; and the mean EH&S program expenditures per 1,000 students, faculty, and staff FTEs were higher for research higher education institutions with student enrollment less than 20,000. Expenditures for the two types of institutions are listed in Table 4.10.

Table 4.10: Expenditures for the two institutions.

Expenditures	**Small institutions (Enrollment < 20K)**	**Large institutions (Enrollment > 20K)**
Mean for EH&S expenditures	$2,353,797.26 (N=19)	$2,491,603.10 (N=39)
Mean for total campus expenditures	$942,892,719.00 (N=19)	$1,248,036,210.95 (N=38)
Mean EH&S program expenditures per student, faculty and staff FTEs	$151.17 (N=19)	$59.60 (N=39)
Mean EH&S program expenditures per 1,000 students, faculty, and staff FTEs	$151,253.36 (N=19)	$59,648.37 (N=39)
Mean EH&S program expenditures per $1M campus expenditures	$2,389.79 (N=19)	$2,365.60 (N=38)

EH&S program expenditures effect on the institution's risk of accidents

To answer the third research question number of reported injuries and illnesses, lost workdays and the number of audits, and citations from federal, state, and local authorities (the dependent variables), were regressed with EH&S program expenditures (the independent variable) for both types of institutions.

EH&S Program expenditures effect on the institution's numbers of reported injuries and illnesses

For both types of institutions, the multiple regression analysis revealed that EH&S program expenditures (the independent variables) were significant in predicting effectiveness in terms of numbers of reported injuries and illnesses (the dependent variables). For institutions with student enrollment less than 20,000 the p value was < 0.004. For institutions with student enrollment greater than 20,000 the p value was < 0.037.

For institutions with student enrollment less than 20,000, the beta coefficient of 0.634 indicates significance in the model. However, for institutions with student enrollment greater than 20,000, the beta coefficient of 0.350 did not find a significant relationship.

For research institutions with student enrollment less than 20,000, the results from the regression analysis found that for every 4.984, or ~5, number of reported injuries and illnesses, the institutions would need $100,000 in EH&S program expenditures to be effective. Put in another way, the EH&S program could save $100,000 for every ~5 number of reported injuries and illnesses that can be prevented. With the R^2 value of 0.367 indicating that 36.7% of the variance in reported injuries and illnesses was explained by the model.

For research institutions with student enrollment greater than 20,000, the multiple regressions yielded that for every 5.676, or ~6, reported injuries and illnesses, the institutions would need $100,000 in EH&S expenditures in order to be effective. In other words, the EH&S program could save $100,000 with every ~6 reported injuries and illnesses that can be prevented. With the R^2 value of 0.096 indicating that 9.6% of the variance in reported injuries and illnesses was explained by the model.

Details of the multiple regression analysis coefficients for the types of institutions in terms of total EH&S program expenditures and the numbers of reported injuries and illnesses are outlined in Table 4.11.

Table 4.11: The relationship between total EH&S program expenditures and the numbers of reported injuries and illnesses.

Coefficients[a]

Model	B	SEB	B	Sig.
1. Small institutions (Enrollment < 20K) Total EH&S Expenditures	4.984E-5	.000	.634	.004
2. Large institutions (Enrollment > 20K) Total EH&S Expenditures	5.676E-5	.000	.350	.037

a. Dependent variable: Reported Injuries and Illnesses
R^2 = 0.367 (Model 1); R^2 = 0.096 (Model 2)

EH&S Program expenditures effect on the institution's numbers of lost workdays

For both institution types, the findings indicate that EH&S program expenditures (the independent variable) are significant and is acceptable regression model for predicting effectiveness in terms of numbers of lost workdays (the dependent variable). For institutions with student enrollment less than 20,000, multiple regression analysis determined the p value was < 0.042 and the beta coefficient was -0.484. For institutions with student enrollment greater than 20,000, the p value was < 0.004 and the beta coefficient of -0.479.

For institutions with student enrollment less than 20,000, the R^2 was 0.187 which indicates 18.7% of the variance in the number of lost workdays was explained by the model. For institutions with student enrollment greater than 20,000, 22.9% of the variance in the number of lost workdays was explained by the model. For both types of institutions, the results from the regression analysis indicate that for every lost workday, the institutions would need $1,000 in EH&S expenditures. In other words, the EH&S program would save $1,000 for every lost day that is prevented.

Table 4.12 provides details of the multiple regression analysis coefficients for the types of institutions in terms of the institutions EH&S program expenditures to numbers of lost workdays.

Table 4.12: The relationship between the total EH&S program expenditures and the numbers of lost workdays.

Coefficients[a]

Model	B	SEB	β	Sig.
1. Small institutions (Enrollment < 20K) Total EH&S Expenditures	-.001	.000	-.484	.042
2. Large institutions (Enrollment > 20K) Total EH&S Expenditures	-.001	.000	-.479	.004

a. Dependent variable: Lost Workdays
R^2 = 0.187 (Model 1); R^2 = 0.229 (Model 2)

EH&S Program expenditures effect on the institution's numbers of audits and citations

The results indicate that EH&S program expenditures(the independent variable) is significant and is a good means of predicting effectiveness in terms of numbers of audits and citations (the dependent variable) for institutions with student enrollment less than 20,000. The multiple regression analysis determined the p value was < 0.001 and the beta coefficient of 0.807.

For research institutions with student enrollment less than 20,000, the results from the regression analysis indicate that for every 2.717, or ~3, audits and citations, the institutions would need $100,000 in EH&S expenditures. In other words, the EH&S program could save $100,000 for every three (3) audits and citations that can be prevented. For institutions with student enrollment less than 20,000, the R^2 was 0.631, which indicates that 63.1% of the variance in the number of audits and citations was explained by the model. For institutions with student enrollment greater than 20,000, EH&S program expenditures was not an acceptable regression model for predicting number of audits and citations for the institutions.

Table 4.13 provides details of the multiple regression analysis coefficients in terms of the total EH&S program expenditures number to the number of audits and citations to the institutions.

Table 4.13: The relationship between the total EH&S program expenditures and the number of audits and citations.

Coefficients[a]

Model	B	SEB	β	Sig.
1. Small institutions (Enrollment < 20K)				
Total EH&S Expenditures	2.717E-5	.000	.807	.000

a. Dependent variable: Federal, state and local compliance inspections
$R^2 = 0.631$ (Model 1)

Summary of the findings for the third research question

To summarize the findings for the third research question, the study found that for both types of research institutions, the mean for EH&S program expenditures, and mean total EH&S program expenditures per one million dollar ($1M) in campus expenditures, are even for all institutions. The study found the mean EH&S program expenditures per student, faculty and staff FTE and expenditures for EH&S program per 1,000 students, faculty, and staff FTE were higher for research higher education institutions with student enrollment less than 20,000. For both types of research institutions, EH&S program expenditures were significant in predicting the numbers of reported injuries and illnesses and the number of lost workdays to the institution.

In predicting effectiveness in terms of the relationship of the number of audits and citations; for institutions with student enrollment less than 20,000, using EH&S program expenditures as a measure, was significant in predicting effectiveness in terms of the number of audits and citations to the institutions. However, for research institutions with student enrollment greater than 20,000, the EH&S program expenditures had no significance.

4.4.4 Summary of the findings for the three research questions

To summarize, the study found that for research institutions with student enrollment less than 20,000, the number of EH&S staff and EH&S expenditures were significant and are good regression models in predicting the number of injuries and illness, the number of lost work days, and the number of audits and citations for this research institution type. The number of EH&S

reporting levels was not significant in predicting the number of injuries and illness , number of lost work days for research institution, and the number of audits and citations.

For research institutions with student enrollment fewer than 20,000, the number of EH&S staff and EH&S expenditures were significant and indicate a strong relationship in predicting the number of injuries and illness and the number of lost work days for this institution type. When compared against EH&S expenditures, the regression models were not as strong in predicting the number of injuries and illness. In addition, the number of EH&S staff and EH&S expenditures was not significant in predicting the number of audits and citations. The number of EH&S reporting levels between the EH&S operations and the upper administration was not significant in predicting the number of injuries and illness, number of lost work days, and the number of audits and citations for this research institution type.

Table 4.14 provides details summary of the finding for the three research question.

Table 4.14: Summary of the finding for the three research question.

	Number of injuries and illness (DV)	Number of lost work days (DV)	Number of audits and citations (DV)	
Number of EH&S FTE staff (IV)	Significant	Significant	Significant	**Small institutions (Enrollment < 20K)**
Number of EH&S reporting levels (IV)	Not significant	Not significant	Not significant	
EH&S expenditures (IV)	Significant	Significant	Significant	
Number of EH&S FTE staff (IV)	Significant	Significant	Not significant	**Large institutions (Enrollment > 20K)**
Number of EH&S reporting levels (IV)	Not significant	Not significant	Not significant	
EH&S expenditures (IV)	Significant	Significant	Not significant	

Note: IV = Independent variable DV = Dependent variable

4.5 Model EH&S programs for the various types of research institutions

In developing models of all-inclusive EH&S programs for the two types of institutions, the study structured and patterned the EH&S programs based on the literature review, the results from the three research questions and data from 2008 CSHEMA Benchmarking Report. The model development consisted of reviewing 58 existing all-inclusive EH&S programs to determine the main components, organizational structure, staffing numbers and expenditures for each of the two types of institutions. All of the relevant information was examined with a focus on effectiveness for each of the models. Once the specifics for each of the types of research higher education institutions were examined, a final model of an all-inclusive EH&S program was constructed for each of the types of research higher education institutions.

4.5.1 Determining the main components for model EH&S programs

Of the 19 institutions with student enrollment less than 20,000, 8 institutions had a centralized organization structure. Of these 8 institutions, 58% had a chemical safety; radiation safety; laboratory safety; fire safety; and risk management. Of the 8 institutions that had a centralized organization structures, biological safety; industrial hygiene/ occupational health safety; and emergency management were found in 52%, 42% and 37% respectively.

Of the 19 institutions with student enrollment less than 20,000, 11 institutions had a fragmented organization structure. Of these 11 intuitions, chemical safety, and risk management were in 42%; biological safety; radiation safety; and laboratory safety were in 37%; emergency management and industrial hygiene/ occupational health safety can be found in 32% in the fragmented organization structure.

Table 4.15 provides details of the types of components for all institutions cited in the study with student enrollment less than 20,000.

Table 4.15: Percentage of the various components for the type of organization structure for institutions with student enrollment less than 20,000.

Type of Components	**Small institutions (Enrollment < 20K)**	
	Central EH&S Organization	Fragmented EH&S Organization
Biological safety	52% (N=10)	37% (N=7)
Chemical safety	58% (N=11)	42% (N=8)
Radiation safety	58% (N=11)	37% (N=7)
Industrial hygiene/ occupational health	42% (N=8)	32% (N=6)
Laboratory safety	58% (N=11)	37% (N=7)
Fire safety	58% (N=11)	42% (N=8)
Risk management	58 % (N=11)	42% (N=8)
Emergency management	37% (N=7)	32% (N=6)
Total	(N=11)	(N=8)

Of the 39 institutions with student enrollment greater than 20,000, 28 institutions had a centralized organization structure. Of 28 institutions, biological safety and chemical safety were in 69%; laboratory safety and risk management were in 67%; radiation safety was in 72%; and fire safety was in 61%; industrial hygiene/ occupational health safety, and emergency management could be found in 46% and 41% respectively.

For the 39 institutions with student enrollment greater than 20,000, 11 institutions had a fragmented organization structure. Of 11 institutions, biological safety, laboratory safety, and risk management components were found in 28%; chemical safety, radiation safety, industrial hygiene/ occupational health safety and fire safety were noted in26% of the entities with fragmented organization structure. Emergency management was found in 23% of the fragmented organization structure organizations. Table 4.16 provides details of the types of components and the organization structure for institutions with student enrollment greater than 20,000.

Table 4.16: Percentage of the various components for the type of organization structure for institutions with student enrollment greater than 20,000.

Type of Components	**Large institutions (Enrollment > 20K)**	
	Central EH&S Organization	Fragmented EH&S Organization
Biological safety	69% (N=27)	28% (N=11)
Chemical safety	69% (N=27)	26% (N=10)
Radiation safety	72% (N=28)	26% (N=10)
Industrial hygiene/ occupational health	46% (N=18)	26% (N=10)
Laboratory safety	67% (N=26)	28% (N=11)
Fire safety	61% (N=24)	26% (N=10)
Risk management	67% (N=26)	28% (N=11)
Emergency management	41% (N=16)	23% (N=9)
Total	(N=28)	(N=11)

Based on these findings, models for the all-inclusive EH&S program for the two types of research higher education institutions were developed. The multiple regression analysis related to the second research question revealed that the organization structure models are not significantly correlated with effectiveness in terms of levels of risk and incident as defined by reported injuries and illnesses, lost workdays, and numbers of audits and citations.

For institutions with student enrollment less than 20,000, two models are presented. The first model has all eight components of the all-inclusive EH&S program within a central organizational structure with two or more reporting levels to higher administration. Organizational reporting structure is not significant to determine effectiveness in terms of levels of risk of accidents and incident as define by: reported injuries and illnesses, lost workdays, and numbers of audits and citations. See Figure 4.2 for graphic representation of the model.

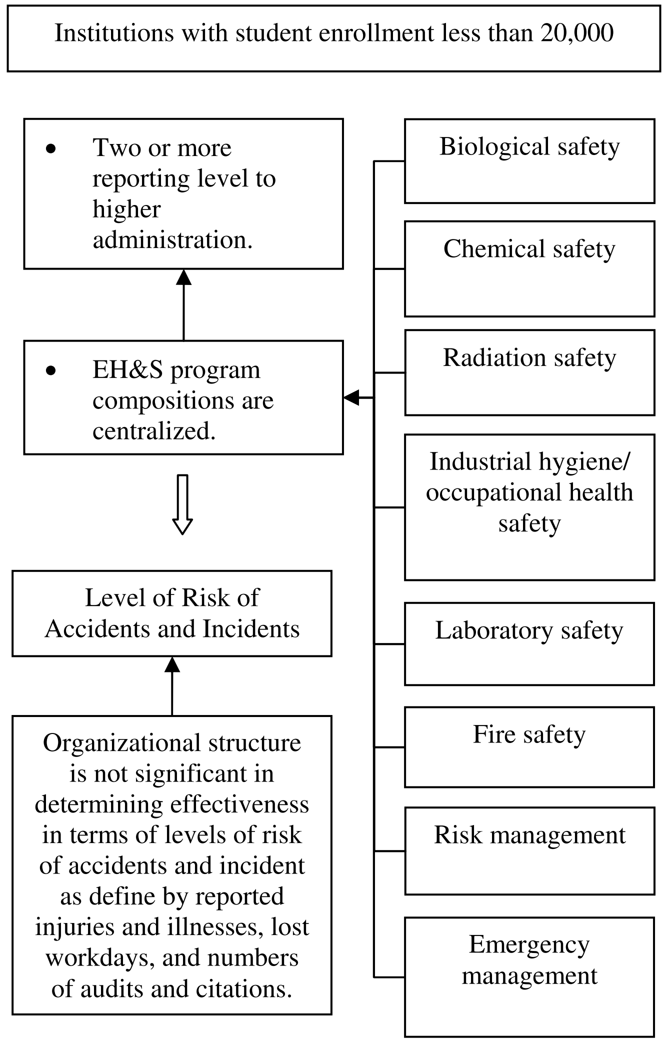

Figure 4.2: Graphic representation of a centralized all-inclusive EH&S program model for institutions with student enrollment less than 20,000.

The second model for institutions with student enrollment less than 20,000 also has all eight components of the all-inclusive EH&S program; however, the EH&S program components have a fragmented organizational structure with one reporting level to higher administration. Organizational reporting structure was not significant in determining effectiveness in terms of levels of risk of accidents and incident as define by: reported injuries and illnesses, lost workdays, and numbers of audits and citations. See figure 4.3 for graphic representation of the model.

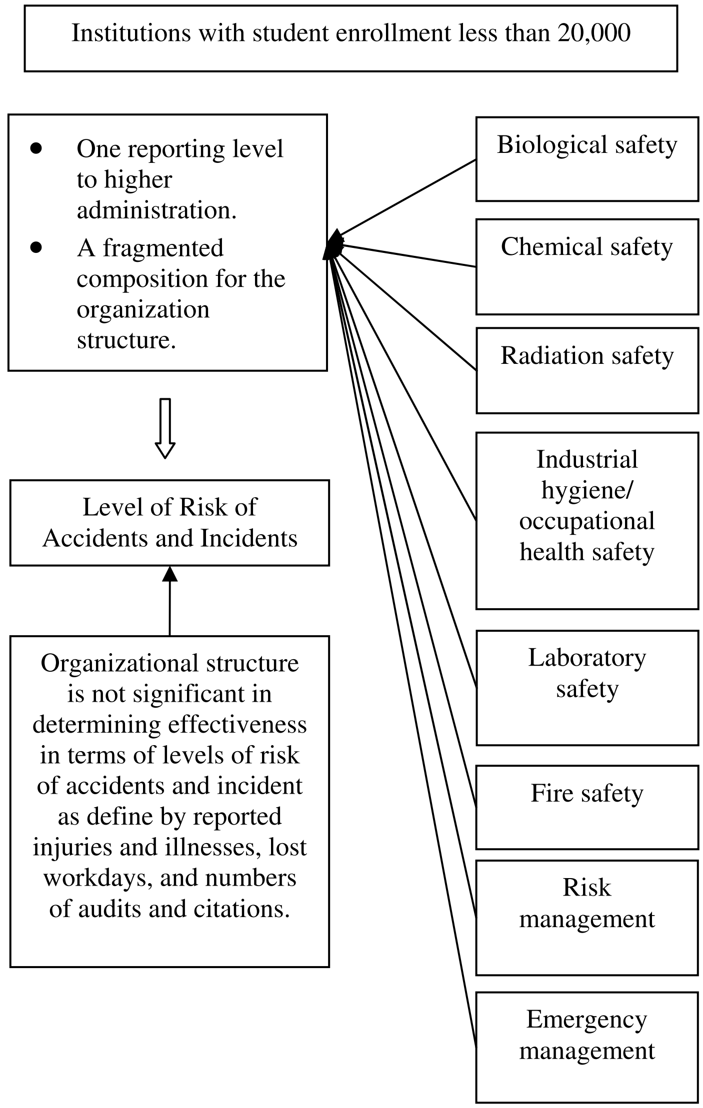

Figure 4.3: Graphic representation of a fragmented EH&S program model for institutions with student enrollment less than 20,000.

For institutions with student enrollments greater than 20,000, all eight of all-inclusive EH&S program components were present with a central organization structure that had two or more reporting levels to higher administration. Organizational reporting structure is not significant to determine effectiveness in terms of levels of risk of accidents and incident as define by: reported injuries and illnesses, lost workdays, and numbers of audits and citations. See figure 4.4 for graphic representation of the model.

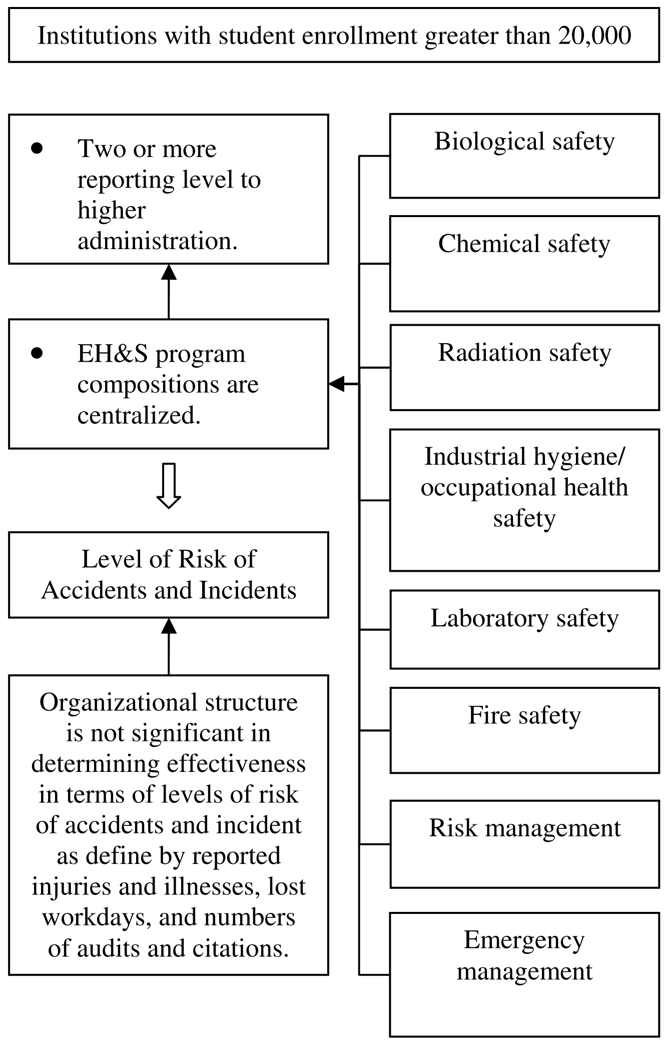

Figure 4.4: Graphic representation of a centralized all-inclusive EH&S program model for institutions with student enrollment greater than 20,000.

For institutions with student enrollment greater than 20,000, all eight components of all-inclusive EH&S program were present with a fragmented organizational structure that had one reporting level to higher administration. Organizational reporting structure is not significant to determining effectiveness in terms of levels of risk of accidents and incident as define by: reported injuries and illnesses, lost workdays, and numbers of audits and citations. See figure 4.5 for graphic representation of the model.

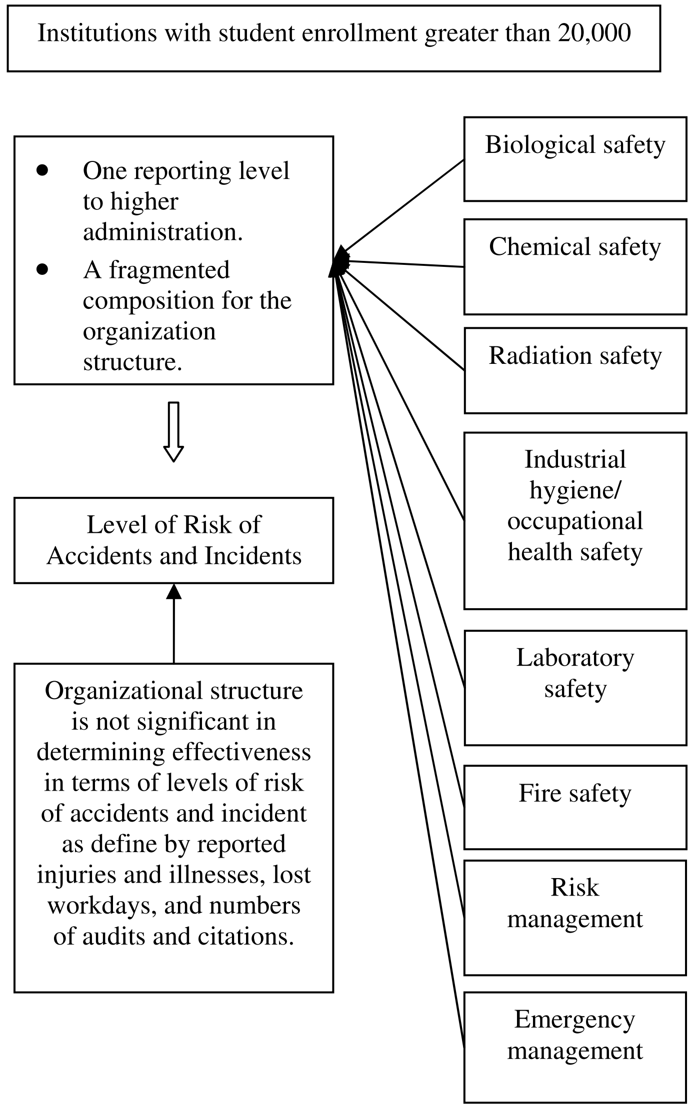

Figure 4.5: Graphic representation of a fragmented EH&S program model for institutions with student enrollment greater than 20,000.

4.5.2 Determining the staff numbers for model EH&S programs

After determining the main components for model EH&S programs the study builds on the four models by examining the staff numbers for the models. Findings from the first research question, using the 2008 CHSEMA Benchmark Report, found 11 institutions with student enrollment less than 20,000 that have a central organizational structure. The mean FTE for biological safety was 2.1; mean FTE for chemical safety was 2.5; mean FTE for radiation safety was 3.6; mean FTE for industrial hygiene/ occupational health safety was 1.4; mean FTE for laboratory safety was 1.8; mean FTE for fire safety was 4.5; mean FTE for risk management was 3.8; mean FTE for emergency management was 1.9; with a total EH&S FTE of 20.5.

For the eight (8) institutions with student enrollment less than 20,000 that have a fragmented organizational structure, the mean FTE for biological safety was 1.9; mean FTE for chemical safety was 3.0; mean FTE for radiation safety was 4.8; mean FTE for industrial hygiene/ occupational health safety was 2.0; mean FTE for laboratory safety was 2.8; mean FTE for fire safety was 2.5; mean FTE for risk management was 2.2; mean FTE for emergency management was 1.1; with a total EH&S FTE of 18.3. Table 4.17 provides details of the components mean FTE for institutions with student enrollment less than 20,000.

Table 4.17: Mean FTE for the various components for institutions with student enrollment less than 20,000.

Type of Components	**Small institutions (Enrollment < 20K)**	
	Central EH&S Organization	Fragmented EH&S Organization
Biological safety mean FTE	2.1 (N=10)	1.9 (N=7)
Chemical safety mean FTE	2.5 (N=11)	3.0 (N=8)
Radiation safety mean FTE	3.6 (N=11)	4.8 (N=7)
Industrial hygiene/ occupational health mean FTE	1.4 (N=8)	2.0 (N=6)
Laboratory safety mean FTE	1.8 (N=11)	2.8 (N=7)
Fire safety mean FTE	4.5 (N=11)	2.5 (N=8)
Risk management mean FTE	3.8 (N=11)	2.2 (N=8)
Emergency management mean FTE	1.9 (N=7)	1.1 (N=6)
Total EH&S mean FTE	20.5 (N=11)	18.3 (N=8)

For the 28 institutions with student enrollment greater than 20,000 that also have a central organizational structure, the mean FTE for biological safety was 2.0; mean FTE for chemical safety was 2.6; mean FTE for radiation safety was 4.7; mean FTE for industrial hygiene/ occupational health safety was 1.8; mean FTE for laboratory safety was 3.1; mean FTE for fire safety was 5.5; mean FTE for risk management was 5.1; mean FTE for emergency management was 1.2; with a total EH&S FTE of 23.1.

For the 11 institutions with student enrollment greater than 20,000 that have a fragmented organizational structure, the mean FTE for biological safety was 3.0; mean FTE for chemical safety was 2.1; mean FTE for radiation safety was 5.4; mean FTE for industrial hygiene/ occupational health safety was 3.3; mean FTE for laboratory safety was 5.4; mean FTE for fire safety was 3.3; mean FTE for risk management was 3.6; mean FTE for emergency management was 1.7; with a total EH&S FTE of 26.2. Table 4.18 provides details of the mean FTE for each component for institutions with student enrollment greater than 20,000.

Table 4.18: Mean FTE for the various components for institutions with student enrollment greater than 20,000.

Type of Components	**Large institutions (Enrollment > 20K)**	
	Central EH&S Organization	Fragmented EH&S Organization
Biological safety mean FTE	2.0 (N=27)	3.0 (N=11)
Chemical safety mean FTE	2.6 (N=27)	2.1 (N=10)
Radiation safety mean FTE	4.7 (N=28)	5.4 (N=10)
Industrial hygiene/ occupational health mean FTE	1.8 (N=18)	3.3 (N=10)
Laboratory safety mean FTE	3.1 (N=26)	5.4 (N=11)
Fire safety mean FTE	5.5 (N=24)	3.3 (N=10)
Risk management mean FTE	5.1 (N=26)	3.6 (N=11)
Emergency management mean FTE	1.2 (N=16)	1.7 (N=9)
Total EH&S mean FTE	23.1 (N=28)	26.2 (N=11)

In building the model EH&S programs for both types of institutions, the information obtained from the multiple regression analysis of the first research question indicated that for both types of organizational structures, the regression models for mean EH&S FTE were significant to establish effectiveness in terms of levels of risks and incidents as defined by reported injuries and illnesses, lost workdays, and numbers of audits and citations. However, for institutions with student enrollment greater than 20,000, the regression models for mean EH&S FTE were not significant to establish effectiveness in terms of levels of risks and incidents as defined by the numbers of audits and citations. The EH&S models are acceptable models for predicting the effectiveness for the levels of risks and incidents to the institutions.

For institutions with student enrollment less than 20,000, two models were developed. The first model consists of all-inclusive EH&S program components within a centralized organizational reporting structure that has at least two or more reporting levels to higher administration. The mean FTE for the various components and the total EH&S program FTE are noted in figure 4.6. Number of EH&S staff is significant to determine effectiveness. In terms of risk of accidents and incidents, one EH& staff is needed for every ~10 reported injuries and illnesses; for every ~97 lost workdays; and for every ~3 numbers of audits and citations to be effective. See figure 4.6 for graphic representation of this model.

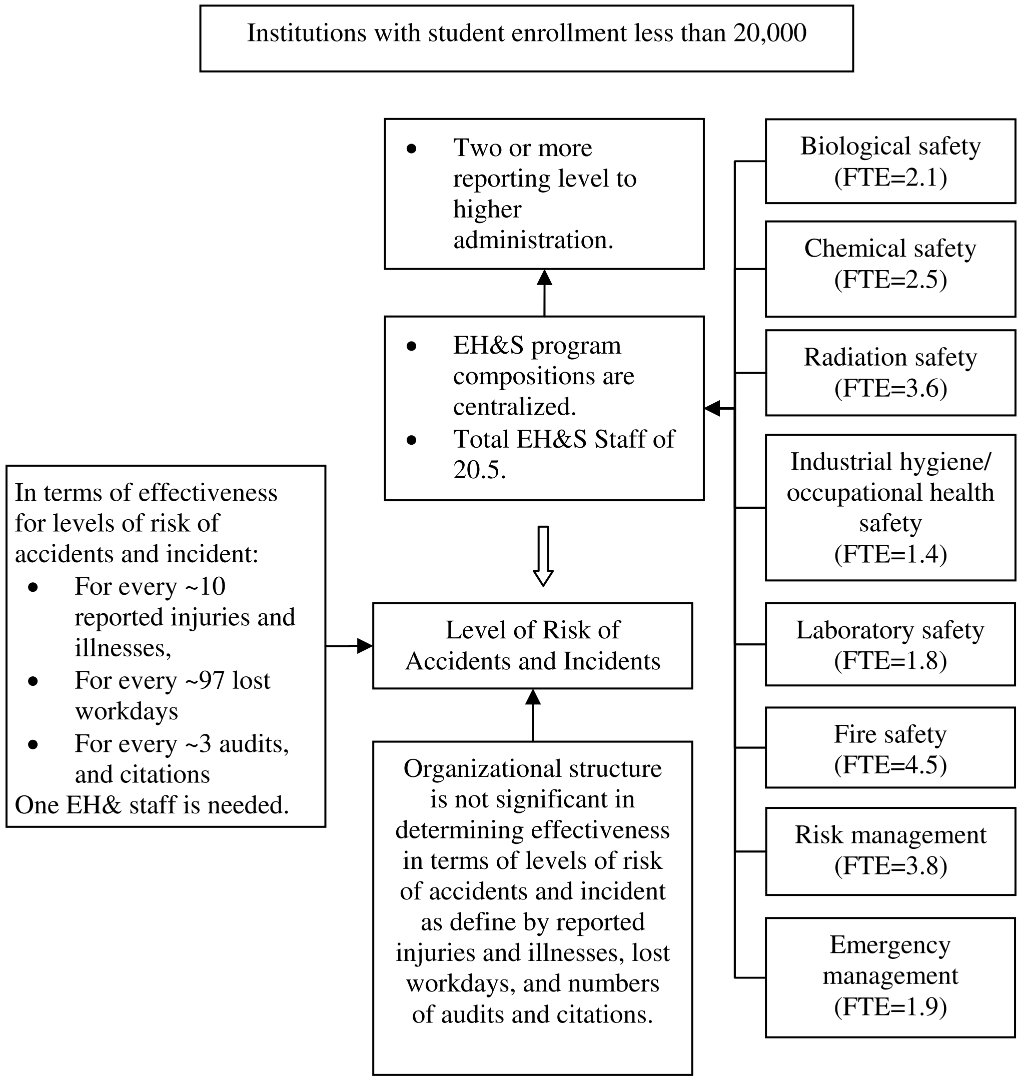

Figure 4.6: Graphic representation of a centralized all-inclusive EH&S program for institutions with student enrollment less than 20,000 with its FTEs.

The second model, for institutions with student enrollment less than 20,000, has a fragmented organizational structure with the various EH&S program components reporting directly (one reporting level) to higher administration. The mean FTE for the various components and the total EH&S program FTE are noted in figure 4.7. The number of EH&S staff is significant to determine effectiveness. In terms of risk of accidents and incidents, one EH& staff is needed for every ~10 reported injuries and illnesses; for every ~97 lost workdays;

and for every ~3 numbers of audits and citations to be effective. See figure 4.7 for graphic representation of this model.

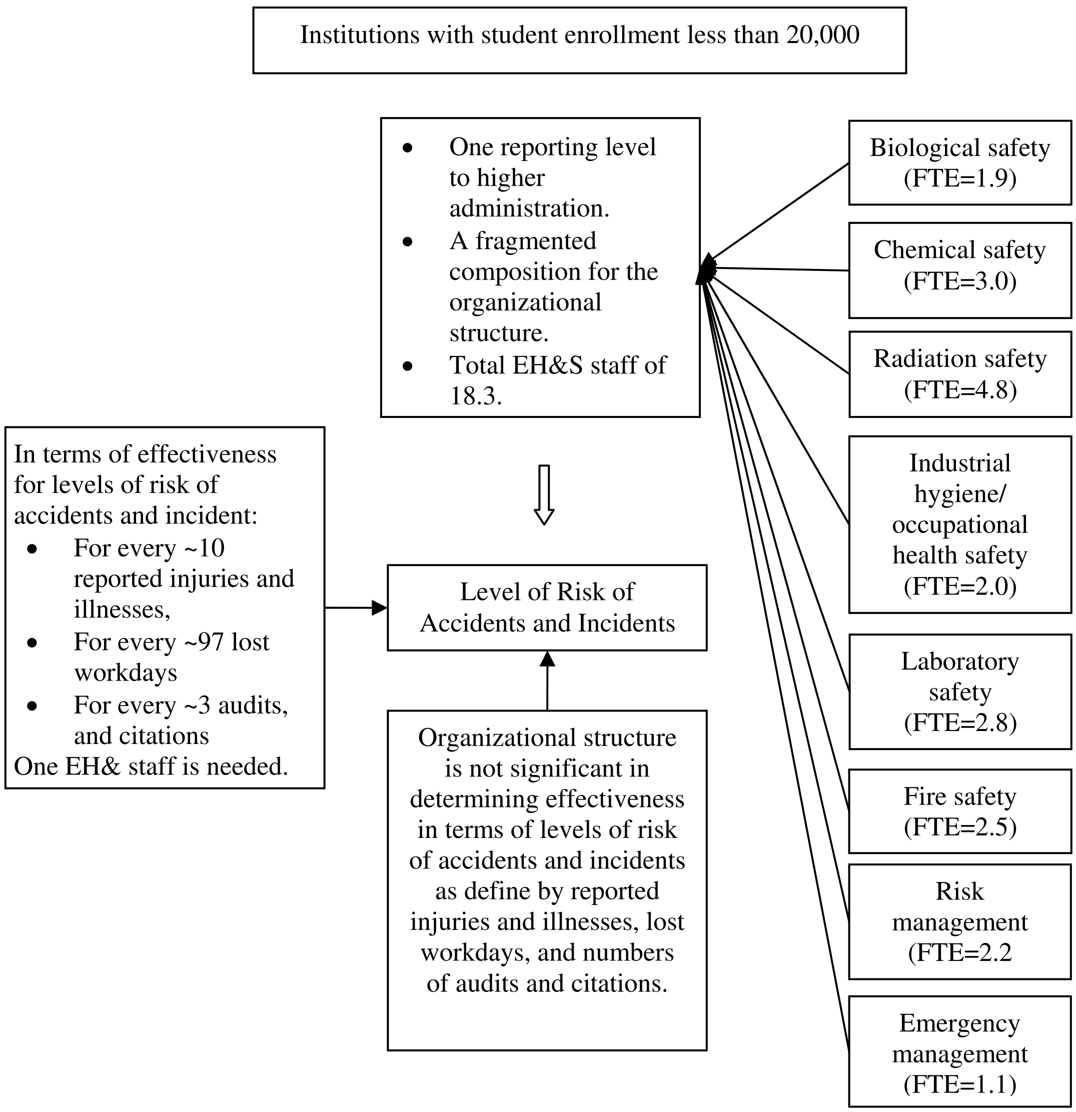

Figure 4.7: Graphic representation of a fragmented all-inclusive EH&S program models for institutions with student enrollment less than 20,000 with its FTEs.

For the EH&S program model for institutions with student enrollment greater than 20,000 that have a central organizational structure with at least two or more reporting levels to higher administration, the mean FTE for the various components and the total EH&S program FTE are noted in figure 4.8. The number of EH&S staff is significant in determining effectiveness in terms of risk of accidents and incidents, as define by reported injuries and illnesses and lost workdays. For effectiveness, one EH& staff is needed for every ~12 reported injuries and illnesses and for every ~103 lost workdays. The numbers of audits and citations is not influence by EH& staff. See figure 4.8 for graphic representation of this model.

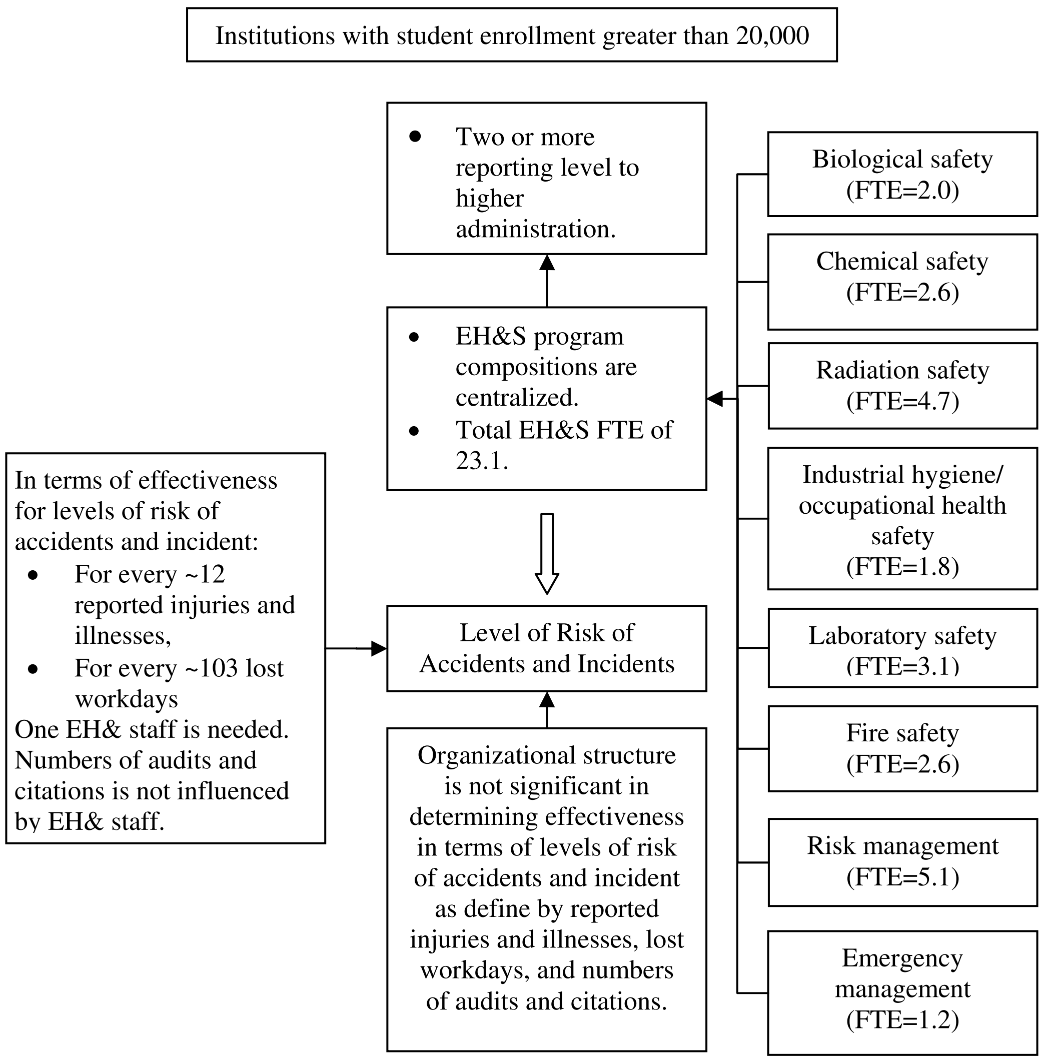

Figure 4.8: Graphic representation of a centralized all-inclusive EH&S program models for institutions with student enrollment greater than 20,000 with its FTEs.

The EH&S program model for institutions with student enrollment greater than 20,000 that have a fragmented organizational structure with one reporting levels to higher administration, the mean FTE for the various components and the total EH&S program FTE are noted in figure 4.9. The number of EH&S staff is significant in determining effectiveness in terms of risk of accidents and incidents, as defined by reported injuries and illnesses and lost workdays. For effectiveness, one EH& staff is needed for every ~12 reported injuries and illnesses and for every ~103 lost workdays. The numbers of audits and citations is not influenced by EH& staff. See figure 4.9 for graphic representation of this model.

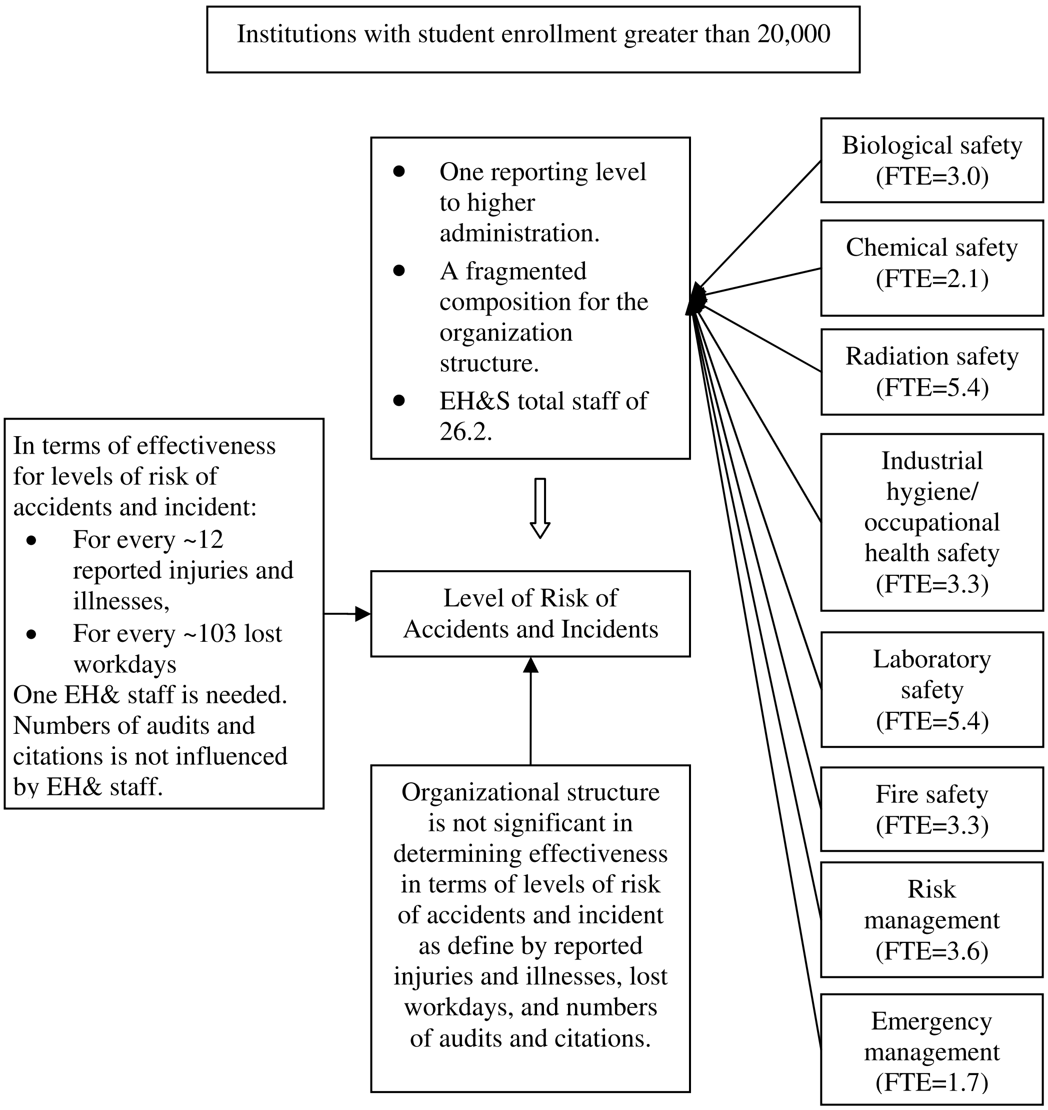

Figure 4.9: Graphic representation of a fragmented all-inclusive EH&S program models for institutions with student enrollment greater than 20,000 with its FTEs.

4.5.3 Determining the expenditures for model EH&S programs

Building on the findings for the model development and by utilizing the findings of the third research question and using the 2008 CHESMA Benchmark Report, the study found 11 institutions with student enrollment less than 20,000 that have a central organizational structure. For these institutions, the study found the mean EH&S expenditures was around $2.16 million; mean total campus expenditures was around $842 million; mean EH&S program expenditures per student, faculty and staff FTEs was around $173; mean EH&S program expenditures per 1,000 students, faculty, and staff FTEs was around $173,000; mean total EH&S program expenditures per $1 million campus expenditure was around $2,300.

For the eight institutions with student enrollment less than 20,000 with fragmented organizational structure, the study found the mean EH&S expenditures was around $2.61 million; mean total campus expenditures was around $1.08 billion; mean EH&S program expenditures per student, faculty and staff FTEs was around $120; mean EH&S program expenditures per 1,000 students, faculty, and staff FTEs was around $120,000; and mean total EH&S program expenditures per $1 million campus expenditures was around $2,300. Table 4.19 provides details of the expenditures for institutions with student enrollment less than 20,000.

Table 4.19: Expenditures for institutions with student enrollment less than 20,000.

Expenditures	**Small institutions (Enrollment < 20K)**	
	Central EH&S Organization	Fragmented EH&S Organization
Mean for EH&S expenditures	$2,162,265.45 (N=11)	$2,617,153.50 (N=8)
Mean for total campus expenditures	$842,588,719.36 (N=11)	$1,080,810,718.50 (N=8)
Mean for EH&S program expenditures per student, faculty and staff FTEs	$173.49 (N=11)	$120.47 (N=8)
Mean for EH&S program expenditures per 1,000 students, faculty, and staff FTEs	$173,587.39 (N=11)	$120,544.06 (N=8)
Mean for total EH&S program expenditures per $1M campus expenditures	$2,386.95 (N=11)	$2,393.67 (N=8)

For the 28 institutions with student enrollment greater than 20,000 that have a central organizational structure, the study found that mean EH&S expenditures was around $2.28 million; mean total campus expenditures was around $1.22 billion; mean EH&S program expenditures per student, faculty and staff FTEs was around $54; mean EH&S program expenditures per 1,000 students, faculty, and staff FTEs was around $54,800; and mean total EH&S program expenditures per $1 million campus expenditures was around $2,300.

For the 11 institutions with student enrollment greater than 20,000 that have fragmented organizational structures, the study found the mean EH&S expenditures was around $3.01 million; mean total campus expenditures was around $1.31 billion; mean EH&S program expenditures per student, faculty and staff FTEs was around $71; mean EH&S program expenditures per 1,000 students, faculty, and staff FTEs was around $71,800; and mean total EH&S program expenditures per $1 million campus expenditures was around $2,400. Table 4.20 provides details of the expenditures for institutions with student enrollment greater than 20,000.

Table 4.20: Expenditures for Institutions with student enrollment greater than 20,000.

Expenditures	**Large institutions (Enrollment > 20K)**	
	Central EH&S Organization	Fragmented EH&S Organization
Mean for EH&S expenditures	$2,284,518.76 (N=28)	$3,018,726.87 (N=11)
Mean for total campus expenditures	$1,220,958,984.89 (N=27)	$1,314,498,493.09 (N=11)
Mean for EH&S program expenditures per student, faculty and staff FTEs	$54.81 (N=28)	$71.80 (N=11)
Mean for EH&S program expenditures per 1,000 students, faculty, and staff FTEs	$54,852.08 (N=28)	$71,857.12 (N=11)
Mean for total EH&S program expenditures per $1M campus expenditures	$2,331.31 (N=27)	$2,449.77 (N=11)

In building the EH&S program models, the regression models for EH&S expenditures are significantly related to the program effectiveness in terms of levels of risk and incident as defined by reported injuries and illnesses, lost workdays, and numbers of audits and citations. However, for institutions with student enrollment greater than 20,000, the regression models for EH&S expenditures were not significant in establishing effectiveness in terms of numbers of audits and citations.

For student enrollment less than 20,000, two models were created. The first model has all-inclusive EH&S program components within a centralized organizational structure that has two reporting levels to higher administration. The mean FTEs for the various components and the total number of EH&S program FTEs are noted in figure 4.10. For this model, the mean EH&S expenditures; mean total campus expenditures; mean EH&S program expenditures per student, faculty and staff FTEs; mean EH&S program expenditures per 1,000 students, faculty, and staff FTEs; and mean total EH&S program expenditures per $1 million campus expenditures are noted in figure 4.10. The EH&S program expenditure is significant in determining effectiveness in terms of risk of accidents and incidents, as defined by reported injuries and illnesses, lost workdays, and numbers of audits and citations. For effectiveness, for every ~5 reported injuries and illnesses that can be prevented, the institutions would save ~$100,000; for every ~1 lost work day prevented, the institutions would save ~$1,000; for every ~3 audits, and citations that can be prevented the institutions would save ~$100,000. See Figure 4.10 for graphic representation of the completed model.

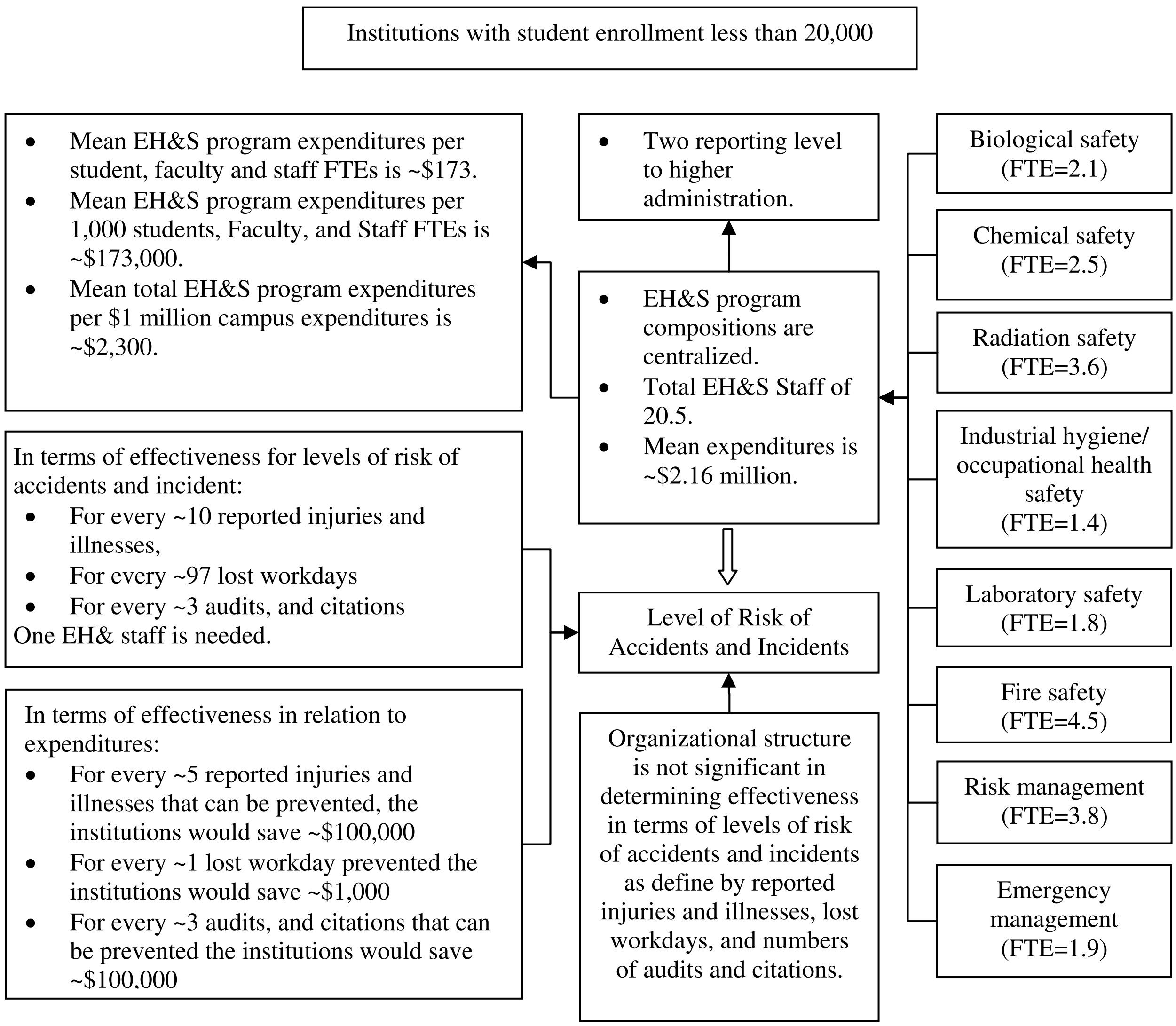

Figure 4.10: Graphic representation of a completed model of a centralized all-inclusive EH&S program for institutions with student enrollment less than 20,000.

The second model for institutions with student enrollment less than 20,000 would have a fragmented organizational structure with the various EH&S program components reporting directly (one reporting level) to higher administration. The mean FTEs for the various components and the total EH&S program FTEs are noted in figure 4.11. For this model, the mean EH&S expenditures; mean total campus expenditures; mean EH&S program expenditures per student, faculty and staff FTEs; mean EH&S program expenditures per 1,000 students, faculty, and staff FTEs; and mean total EH&S program expenditures per $1 million campus expenditures are noted in figure 4.11. The EH&S program expenditures are significant in determining effectiveness in terms of risk of accidents and incidents, as defined by reported injuries and illnesses, lost workdays, numbers of audits and citations. For effectiveness, for every ~5 reported injuries and illnesses that can be prevented, the institutions would save ~$100,000; for every ~1 lost work day prevented, the institutions would save ~$1,000; for every ~3 audits, and citations that can be prevented, the institutions would save ~$100,000. See Figure 4.11 for graphic representation of the completed model.

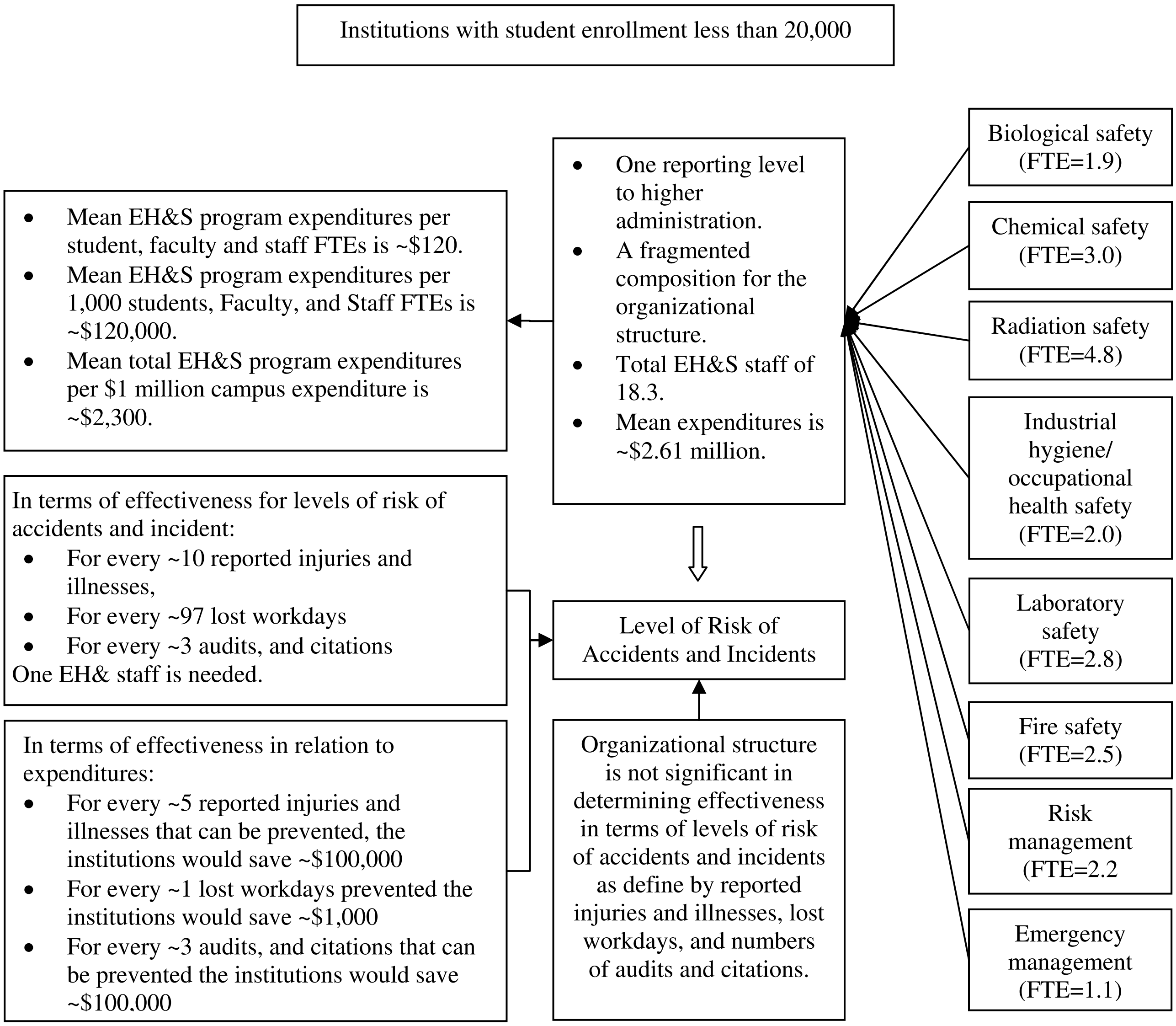

Figure 4.11: Graphic representation of a completed model for a fragmented all-inclusive EH&S program for institutions with student enrollment less than 20,000.

The model of an EH&S program for institutions with student enrollment greater than 20,000 that have a centralized organizational structure with two reporting levels to higher administration is described. The mean FTEs for the various components and the total EH&S program FTEs are noted in figure 4.12. For this model, the mean EH&S expenditures; mean total campus expenditures; mean EH&S program expenditures per student, faculty and staff FTEs; mean EH&S program expenditures per 1,000 students, faculty, and staff FTEs; and mean total EH&S program expenditures per $1 million campus expenditures are noted in figure 4.12. The EH&S program expenditures are significant in determining effectiveness in terms of risk of accidents and incidents, as defined by reported injuries and illnesses and lost workdays. For every ~6 reported injuries and illnesses that can be prevented, the institutions would save ~$100,000; for every ~1 lost workdays prevented the institutions would save ~$1,000. The numbers of audits and citations is not influenced by EH&S program expenditures. See Figure 4.12 for graphic representation of the completed model.

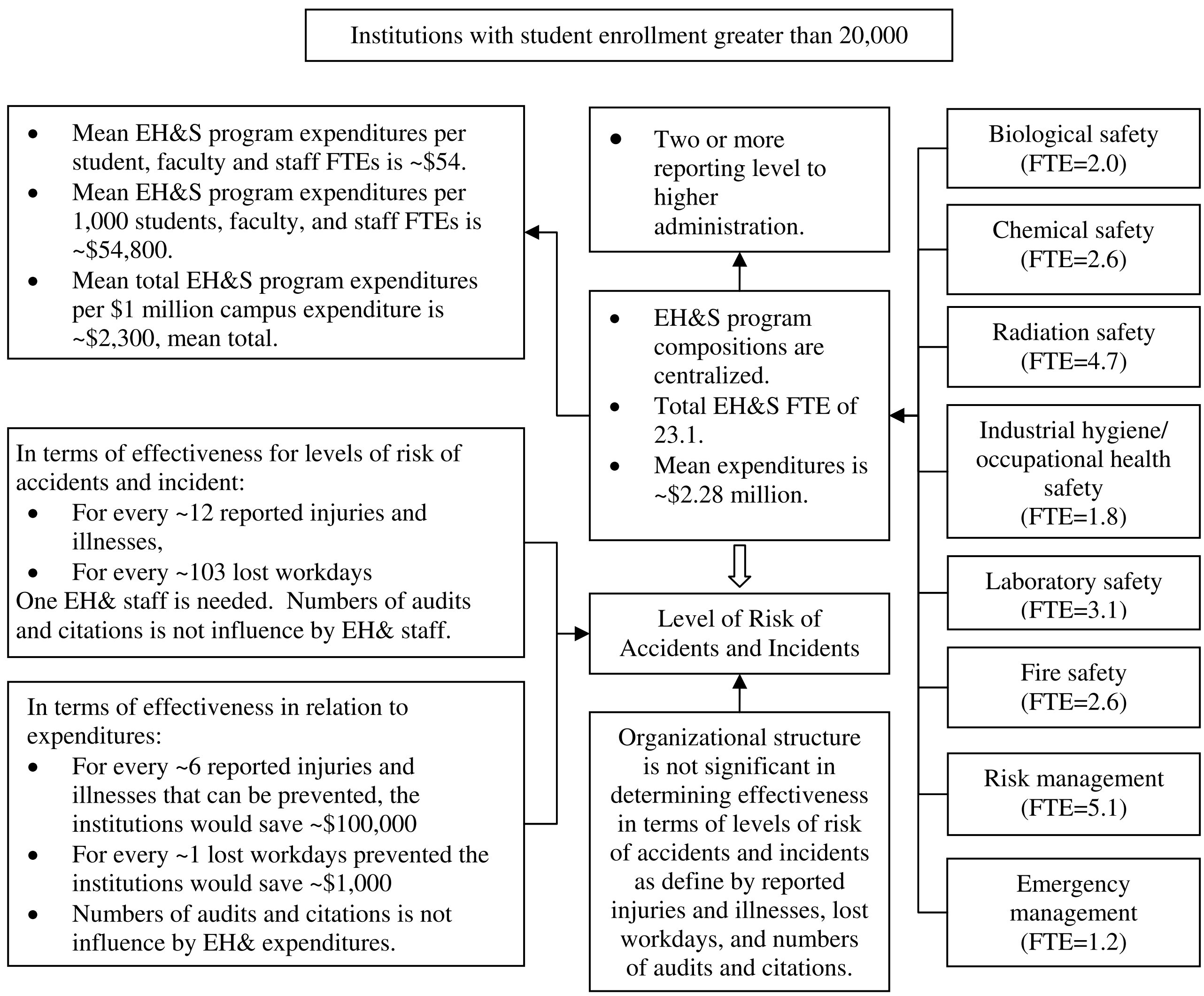

Figure 4.12: Graphic representation of the completed model of a centralized all-inclusive EH&S program for institutions with student enrollment greater than 20,000.

The model of an EH&S program for institutions with student enrollment greater than 20,000 with a fragmented organizational structure (one reporting level to higher administration) is described. The mean FTEs for the various components and the total EH&S program FTEs are noted in figure 4.13. For this model, the mean EH&S expenditures; mean total campus expenditures; mean EH&S program expenditures per student, faculty and staff FTEs; mean EH&S program expenditures per 1,000 students, faculty, and staff FTEs; and mean total EH&S program expenditures per $1 million campus expenditures are noted in figure 4.13. The EH&S program expenditures are significant in determining effectiveness in terms of risk of accidents and incidents, as define by reported injuries and illnesses and lost workdays. For every ~6 reported injuries and illnesses that can be prevented, the institutions would save ~$100,000; for every ~1 lost workdays prevented the institutions would save ~$1,000. The numbers of audits and citations is not influenced by EH&S program expenditures. See Figure 4.13 for graphic representation of the completed model.

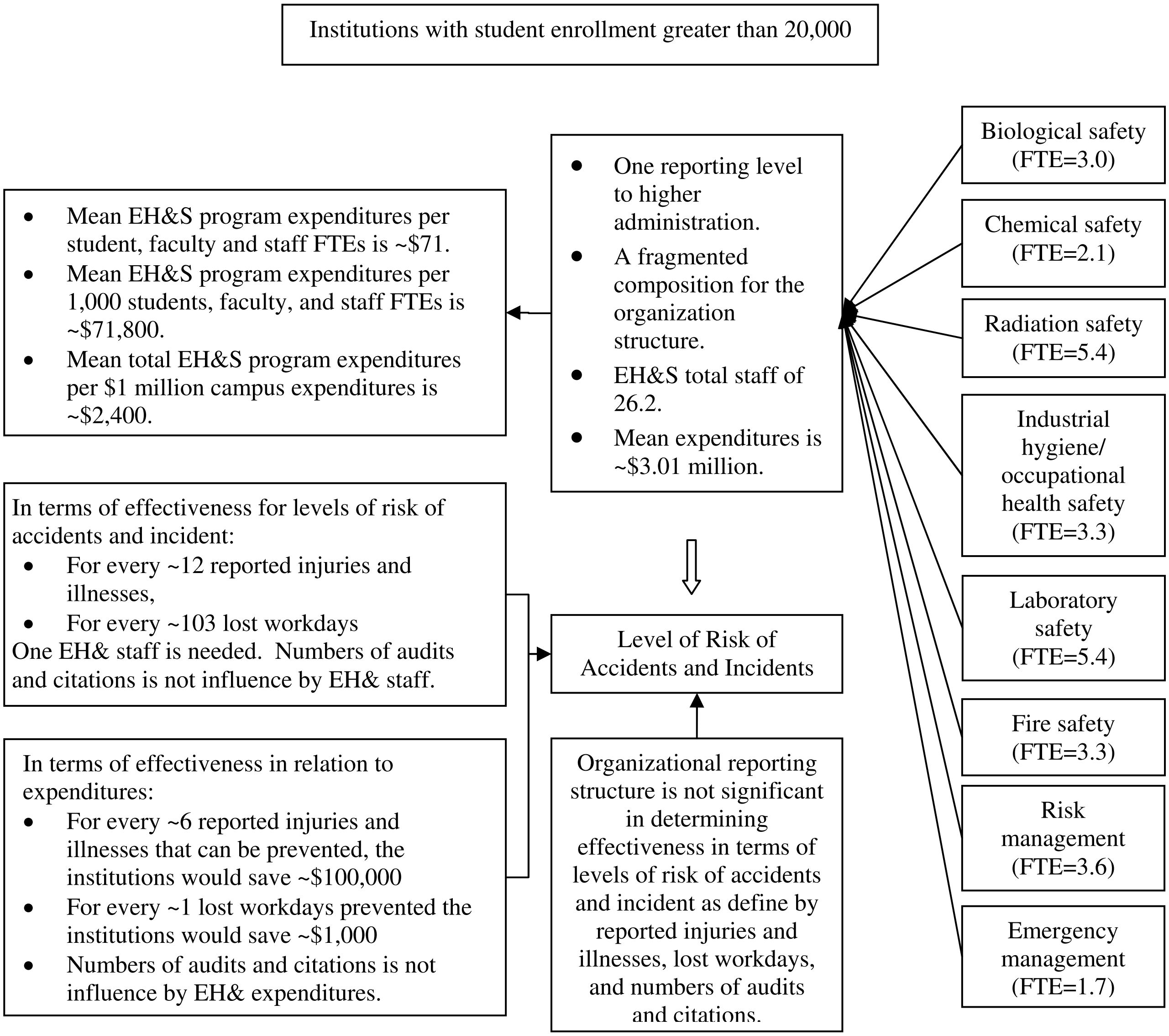

Figure 4.13: Graphic representation of the completed model of a fragmented EH&S program for institutions with student enrollment greater than 20,000.

4.6 Comparison of the various EH&S programs models

This chapter concludes with a comparison of the different models of all-inclusive EH&S programs for both types of higher education institutions. From the study, four models were developed for EH&S programs for the two types of research higher education institutions based on student population. Figure 4.10 was a graphic representation of the completed model of a centralized all-inclusive EH&S program for institutions with student enrollment less than 20,000. Figure 4.11 was a graphic representation of the completed model of a fragmented all-inclusive EH&S program for institutions with student enrollment less than 20,000. Figure 4.12 was a graphic representation of a centralized all-inclusive EH&S program for institutions with student enrollment greater than 20,000. Figure 4.13 details the completed model for a fragmented EH&S program for institutions with student enrollment greater than 20,000.

4.6.1 Comparison of the components on various EH&S program models

For the two types of research higher education institutions, the all-inclusive EH&S programs have the same program components which consist of biological safety, chemical safety, radiation safety, industrial hygiene/ occupational health safety, laboratory safety, fire safety, risk management and emergency management.

4.6.2 Comparison of the staff on the various EHS program models

For the two types of research institutions, both centralized and fragmented organizational structures, staffing for biological safety; chemical safety; radiation safety; and emergency management are comparable. However, the ratio between the total EH&S FTEs is smaller for research higher education institutions that have student enrollment greater than 20,000 when compared to the research higher education institutions that have student enrollment less than 20,000.

For institutions with less than 20,000, the total EH&S staff is significant to determine effectiveness in terms of levels of risk of accidents and incidents as define by reported injuries and illnesses, lost workdays, and numbers of audits and citations. For institutions with greater than 20,000, the total EH&S staff, is significant in determining effectiveness in terms of levels of risk of accidents and incidents as define by reported injuries and illnesses, lost workdays, but not for numbers of audits and citations.

Table 4.21 provides details of staffing on the various EH&S programs models.

Table 4.21: Details of staffing on the various EH&S programs models.

Type of Components	Small institutions (Enrollment < 20K)		Large institutions (Enrollment > 20K)	
	Centralized EH&S Organization	Fragmented EH&S Organization	Central EH&S Organization	Fragmented EH&S Organization
Biological safety mean FTE	2.1 (N=10)	1.9 (N=7)	2.0 (N=27)	3.0 (N=11)
Chemical safety mean FTE	2.5 (N=11)	3.0 (N=8)	2.6 (N=27)	2.1 (N=10)
Radiation safety mean FTE	3.6 (N=11)	4.8 (N=7)	4.7 (N=28)	5.4 (N=10)
Industrial hygiene/ occupational health mean FTE	1.4 (N=8)	2.0 (N=6)	1.8 (N=18)	3.3 (N=10)
Laboratory safety mean FTE	1.8 (N=11)	2.8 (N=7)	3.1 (N=26)	5.4 (N=11)
Fire safety mean FTE	4.5 (N=11)	2.5 (N=8)	5.5 (N=24)	3.3 (N=10)
Risk management mean FTE	3.8 (N=11)	2.2 (N=8)	5.1 (N=26)	3.6 (N=11)
Emergency management mean FTE	1.9 (N=7)	1.1 (N=6)	1.2 (N=16)	1.7 (N=9)
Total EH&S mean FTE	20.5 (N=11)	18.3 (N=8)	23.1 (N=28)	26.2 (N=11)

4.6.3 Comparison of the organizational reporting structure on various EH&S programs models

For both institution types, the models outlined have either a centralized or a fragmented organizational reporting structure. For both types of institutions, the type of organizational structure is not significant in determining effectiveness in terms of levels of risk of accidents and incidents as defined by reported injuries and illnesses, lost workdays, and numbers of audits and citations.

4.6.4 Comparison of expenditures on various EH&S program models

For both types of institutions, the type of organizational structure, the EH&S program expenditures and the total EH&S program expenditures per $1M campus expenditures are relatively even. The study found that for both types of institutions and both types of organization structures, EH&S program expenditures per student, faculty and staff FTEs; and EH&S program expenditures per 1,000 students, faculty, and staff FTEs are higher for institutions with student enrollment less than 20,000. The study also found that the total campus expenditures are larger for institutions with student enrollment greater than 20,000. Furthermore, for those EH&S programs with centralized organizational structure, the expenditures are lower than for those with the fragmented organizational structure. Table 4.22 provides details for expenditures on the various EH&S programs models.

Table 4.22: Details of the expenditures on the various EH&S programs models.

Expenditures	**Small institutions (Enrollment < 20K)**		**Large institutions (Enrollment > 20K)**	
	Centralized EH&S Organization	Fragmented EH&S Organization	Central EH&S Organization	Fragmented EH&S Organization
Mean for EH&S expenditures	$2,162,265.45 (N=11)	$2,617,153.50 (N=8)	$2,284,518.76 (N=28)	$3,018,726.87 (N=11)
Mean for total campus expenditures	$842,588,719.36 (N=11)	$1,080,810,718.50 (N=8)	$1,220,958,984.89 (N=27)	$1,314,498,493.09 (N=11)
Mean for EH&S program expenditures per student, faculty and staff FTEs	$173.49 (N=11)	$120.47 (N=8)	$54.81 (N=28)	$71.80 (N=11)
Mean for EH&S program expenditures per 1,000 students faculty, and staff FTEs	$173,587.39 (N=11)	$120,544.06 (N=8)	$54,852.08 (N=28)	$71,857.12 (N=11)
Mean for total EH&S program expenditures per $1M campus expenditure	$2,386.95 (N=11)	$2,393.67 (N=8)	$2,331.31 (N=27)	$2,449.77 (N=11)

For institutions with less than 20,000, the EH&S program expenditures, is significant in determining effectiveness in terms of levels of risk of accidents and incidents as defined by reported injuries and illnesses, lost workdays, and numbers of audits and citations. For institutions with greater than 20,000, the total EH&S program expenditures are significant in determining effectiveness in terms of levels of risk of accidents and incidents as defined by reported injuries and illnesses, lost workdays, but not for numbers of audits and citations.

4.7 Summary

Most colleges and universities in the United States have EH&S programs. However, few, if any, studies have been done to examine and explore what EH&S programs are comprised of, how they are organized and structured, how they are staffed and funded, what role they play in serving higher education institutions and what effect they have on risks, accidents and incidents at the institutions.

This chapter provided the findings in terms of answers to the three research questions as well as depicting the various models of all-inclusive EH&S programs that outlined: composition, organization levels, expenditures and the effect they have on risks and incidents to the institutions. Through the findings and developing these models, this study expand the limited knowledge and literature regarding EH&S programs in higher education institutions. Results of this study provide a baseline for additional research on this topic in the future.

CHAPTER FIVE

CONCLUSION

In this final chapter, a discussion of the study's results are examined and presented. The opening section provides a detailed discussion of the study's results. The second section offers possible implication for higher education research institutions administrators on how to have an effective Environmental Health and Safety (EH&S) program. The third section details the current study's limitations. This chapter closes by addressing future research directions based on this study's results follow by a summary of the study.

5.1 Discussion

Prior to this study, little was known about all-inclusive EH&S programs. Often, when studies are done on EH&S programs, the study examines only an individual component of the EH&S program such as radiation or chemical safety. This study is different in that it takes into account the various components that make up an EH&S program rather than individual components. In doing so, this study has attempted to add to the existing literature on EH&S programs by providing a greater detail on the composition of all-inclusive EH&S programs. In addition, a broader perspective is offered to describe how all-inclusive EH&S programs are organized and how this relates to the number of reporting levels to the upper administration. Furthermore, a better understanding of EH&S program expenditures is provided. Finally, new knowledge has been gained on what effect EH&S programs have in terms of accident and incident to the institution.

5.1.1 Make up of an all-inclusive EH&S program

Prior to this study, not much has been written to determine the components of an all-inclusive EH&S program. From the findings in Chapter Four, eight (8) components: biological safety, chemical safety, radiation safety, laboratory safety, fire safety, risk management, industrial hygiene/ occupational health, and emergency management make up an all-inclusive EH&S program. In addition, what has now been discovered is that these eight components are considered the main components for an all-inclusive EH&S program. Since no other studies have been done to determine the typical make up of an all-inclusive EH&S program, the results from Chapter Four can only state that these eight components are considered the typical components of an all-inclusive EH&S program. Prior to this study, the components that comprised an all-inclusive EH&S program were speculative. What is learned from determining the main components for an EH&S program is that even though EH&S programs may vary from one institution to next, they most likely have some aspect of these eight main components.

No other research was found that had been conducted to determine whether the combination of these components and their associated staff of an EH&S program have a significant effect on accidents and incidents to the institution. This study concluded that from the findings in Chapter Four, the total number of EH&S FTEs per components has a significant effect on the risks of accidents and incidents in terms of number of injuries and illness and number of lost work days. These findings are important and suggest that EH&S personnel are essential to ensure the institution is functioning in a safe manner.

This study also found that the ratio between EH&S staff per 1,000 students, faculty, and staff to be smaller for large institutions (those that have student enrollment greater than 20,000). Before this study, no clear distinction for EH&S staff ratios between large and small institutions was noted. Since no other studies have noted the ratio difference for the types of institutions, this study can state that for institutions that have student enrollment less than 20,000, the ratio for EH&S staff for every 1,000 students, faculty, and staff is 1.4, and for institutions that have student enrollment greater than 20,000, the ratio is 0.6; a difference of 0.8. This finding is significant and suggests that to ensure the safety of the institution, there is a ratio difference for the different type of institutions. While this study and its findings did not look at the efficiency in terms of EH&S staff ratios, there appears to be an efficiency factor that might be associated with the size of the institution and EH&S staff that could be further investigated.

Furthermore, it was learned that often the establishment of these EH&S components is in direct response to increased regulatory requirements in support of worker safety and environmental protection to general industries, especially those that involve hazardous, volatile materials or other substances as well as dangerous work activities. What is also now known from the literature review is that this is in response to the slowly evolving promulgation of new regulations and an increase in the general awareness of the impact of hazardous material and its use. As a result, EH&S programs were added piecemeal over several decades to ensure that associated safety concern are addressed. This patch work composition of an all-inclusive EH&S program is noted and based on the literature review and from the findings of the study that show the progression of the various components when rules, regulations, and guidelines require these safety components be implemented.

5.1.2 EH&S program organization

In discussing EH&S organizational structure, prior to this study, little was known about how EH&S programs are organized in terms of reporting levels. From the results of the study, it is clear that there are two organizational structures, centralized and fragmented. In a centralized organizational structure, there are multiple reporting levels within each of the EH&S components and the components are within a dedicated EH&S program. Each of these components reports to a program director who in turn reports to the institution's upper administration. In a fragmented organizational structure, each of the EH&S components are not associated with one another and report to the institution's higher administration separately. Before this study, no clear formulation of the organizational structure of an all-inclusive EH&S program in terms of the number of reporting levels was carried out. The findings from this study provide clarification of the two types of organizational structures found in an all-inclusive EH&S program in terms of reporting levels.

Furthermore, it has also been determined that the number of reporting levels to the institution's upper administration is apparently not significant in determining effectiveness in terms of risk of accidents and incidents to the institution. In this study, not finding a discernible significance in the organizational structure may be an important result. This finding is encouraging for the fact in the current EH&S program setting, most often when colleges and universities are asked to conform to new rules and regulations or mandates, they often do so without specific direction on how to develop and implement their programs. As a result, a wide variety of organizational structures are established. So by finding that the organizational structures and reporting levels has no significance validates the current trend that when higher education institutions are required to abide to new safety laws, they do so without regard to a specific administrative structure but rather with an eye towards the quickest and most efficient route for the individual institution.

Of further note, this study cannot know if the ideal EH&S organization - in terms of functionality - is represented by a particular structure that could simply be adopted universally to achieve a high level of effectiveness at a relatively low cost. To speculate, one possible explanation for this condition is that rules, regulations, and guidelines are constantly evolving. A single EH&S organization structure may not be effective to ensure proper safety for all institutions. As a result, one could speculate that research institutions must adjust according to their own, individual structure to be effective. Therefore, as the study did not find significance for one organizational structure or reporting levels seems to validate this point.

5.1.3 EH&S expenditures

Before this study, not much was known about an all-inclusive EH&S program expenditures. From the results, what is now known is that EH&S expenditures do have a significant effect on an institution's risk of accident and incident in terms of number of injuries and illness and lost work days. This finding is important and suggests that an all-inclusive EH&S program expenditures are essential to ensure the safety of the institution. Prior to this study, it is not certain if all-inclusive EH&S program expenditures were essential to ensure safety for the institution. From the results, it is clear that EH&S program expenditures are essential to ensure the safety as related to the number of injuries and illness and lost work days to the institution.

EH&S program expenditures are essential to ensure the safety of the institution as noted from the results of the study. One major factor that was discovered was that among all research institutions, for every one million dollar campus expenditures, an EH&S program would need at least $2,300 to be effective in terms of safety for the institution. The importance of this finding is that regardless of the size of the institution, there is a key amount that an EH&S program needs to ensure safety for the institution. This finding in the study is meaningful as in the current economic climate, colleges and universities are being asked to cut budgets and save on expenditures. When budget cuts are necessary, safety programs are among the hardest hit. As a result of budget cuts to safety programs, colleges and universities are susceptible to accidents and incidents. So by discovering a key amount that an EH&S program needs to ensure proper safety for the institution; when the institutions are forced to cut, they now know how much they must limit any budget cuts to EH&S to ensure proper safety for student, faculty and staff.

5.1.4 Models of EH&S programs

Prior to this study it was known that while many, if not all, universities and colleges have some kind of health and safety program in place to address workplace safety and environmental protection. However, before this study, no study had examined all-inclusive EH&S programs at various institutions based on student enrollment size. In conducting this study, the researcher believed that an examination of the composition of all-inclusive EH&S program, various organizational reporting schemes and the program expenditures; coupled with the careful analysis of the effectiveness of these programs and how they impact the university seems long overdue.

By examining EH&S programs in various models, the knowledge gained can be quickly examined and digested. However, it is important to understand that these models are reasonably simplified representations of real world situations. They are abstractions of reality. Therefore they represent an ideal view of an EH&S program. As such, caution is warranted when applying these models to current real world EH&S programs.

What is now known from the four models that were developed is that in an ideal setting, all eight safety components are present for both small and large institutions. Furthermore, the study found that for both small and large institutions, the two types of organizational structures, centralized and fragmented, can be found. In addition, the findings from the models reveled that for institutions that have a fragmented organizational structure, EH&S expenditures are higher than for those that have a centralized organizational structure.

While the models for both types of research institutions revealed EH&S program expenditures, EH&S program expenditures per one million dollar ($1M) campus expenditures are relatively even for all institutions; the study found when the expenditures were adjusted in terms of EH&S program expenditures per student, faculty and staff FTEs and expenditures for

EH&S program per 1,000 students, faculty, and staff FTEs, were higher for research higher education institutions with student enrollment less than 20,000. This would suggest for research higher education institutions with student enrollment greater than 20,000 are more efficient in terms of expenditures.

What has been revealed in the models is that despite not finding any significant effect for the type of organizational structure on the risk of accidents and incidents to the institution, it would appear that type of organizational structure as well as the size of the institution does have an effect on expenditures in terms of efficiency. This finding is important in the current climate of higher education institutions who are trying to find ways to reduce costs and expenditures. While this study and its findings did not look at the efficiency in terms of expenditures, knowledge gained from these models shows that there appears to be an efficiency factor that might be associated with the size of the institution and the organizational structure of EH&S programs in terms of the number of reporting levels to higher administration.

5.2 Possible implications

For higher education administrators, several implications can be inferred from the results of this study and the models of the various EH&S programs that have been developed. One possible implication that higher education administrators can apply is in terms of EH&S staffing numbers. From the findings, higher education administrators now have a working understanding of the staff numbers needed for each component of the program to ensure that their EH&S program is effective. From the models outlined in Chapter Four, higher education administrators can quickly determine if each of the major components of their EH&S program have the proper number of staff to achieve a sound safety program. In addition, higher education administrators have a general ideal in terms of effectiveness for levels of risk of accidents and incident.

As an example, for those institutions with student enrollment less than 20,000 higher education administrators now know that in order to ensure effectiveness, the institutions could prevent approximately 10 reported injuries and illnesses, and prevent approximately 97 lost workdays, and prevent approximately three (3) audits and citations if they have one EH& staff in place. A word of caution is necessary as the models developed in Chapter Four are generalized depictions of how EH&S programs should be established for the various institution types. They are a conceptualizations that should help facilitate a better understanding of EH&S programs but variations will likely be necessary based on institutional type, size, and circumstances. Therefore, care should be taken when apply these models to current real world EH&S programs.

Furthermore, the findings have shown that the organizational structure in terms of number of reporting levels has no effect on the institution's risk and incidents. By knowing this, higher education administrators can choose to have a micro management or loose management style that best suits them and their institution. However, of further note, while this current study did not look at the organization reporting level and expenditures as it relates to efficiency; findings from the models indicates that there appears to be an association between the number of reporting levels and expenditures in terms of efficiency. Additional caution is needed when considering the organizational structure in terms of number of reporting levels as it relate to effectiveness instead of efficiency.

Another possible implication that higher education administrators can apply is in terms of the amount of EH&S fund expenditures required for an effective program. Higher education administrators now have a general picture of how EH&S funds should be allocated for their institutions to ensure that they are being fiscally responsible. Based on the findings, higher education administrators now know that for every $1,000, 000 in campus expenditures, they would need to allocate at least $2,300 to their EH&S program to ensure proper safety for the institution. By knowing this amount, higher administration have a foundation on how much to fund for an EH&S program.

5.3 Limitations

Several limitations may have influenced the study's results, findings and conclusions. The first limitation was the survey sample. The sample selected for this study came from the 2008 CSHEMA Benchmarking Report population. The participants from the 2008 CSHEMA Benchmarking Report represented a convenience sample. Therefore, it is not possible to generalize the results to all research higher education institutions.

Another noted limitation was the sample used. The sample only considered colleges and universities that conducted natural and/or physical science research, have at least one EH&S

component, and have an enrollment of greater than 5,000 students. The study did not include institutions that do not conduct natural and/or physical science research or have an enrollment less than 5,000 students. As a result, the findings and conclusions could only be applied to the types of institutions it describes.

One other limitation were the restrictions placed on the study. The study restricted the types of EH&S components used in the study. Other safety related components were not used in the study. Therefore, inclusion of these components may have some influence on the study results.

Another limitation is in the four models that have been developed. As noted earlier, these models are reasonably simplified representations of real world situations that represent an idealist view of an EH&S program. As a result, in real world situations certain aspects of the models could not be applied. As an example, there may be institutions that have a combination of a fragment organization reporting structure for certain safety components while retaining characteristics of an all-inclusive EH&S program that has a centralized organization reporting structure for other components. As such, caution is warranted when applying these models to current real world EH&S programs.

It is also important to note that this study provides an understanding of colleges and universities conducted during a “snapshot in time.” Underlying dynamics, such as university changes or unique histories (e.g., collecting data on items such as recent regulatory compliance fines or negative media coverage) were not a consideration and those relationships were not explored. Based on the sample selection and restrictions placed on the study, the time period of the data collection may influence the study results, findings and conclusion. Nonetheless, the study does provide a cohesive groundwork for other studies to be conducted in this area of research. Professionals in health and safety as well as higher education administration professionals can benefit from this research by gaining a better understanding of EH&S programs for research higher education institutions.

5.4 Future research directions

It is known that colleges’ and universities’ EH&S programs will change and grow significantly over the years in order to adapt to new safety needs of the institution as well as new federal and local laws and mandates that may be enacted. In order to better understand the changes and the safety needs of the institution, prospective studies should be conducted that build on the information collected through this research study.

Several suggestions for future research can be inferred from the results of this study. As revealed from the findings and from various models of EH&S programs, one critical area that future research can focus on is, in addition to measuring effectiveness in terms of accidents and injuries, is to measures efficiency of the EH&S programs as well. As noted from the discussion above, for future studies, efficiency can be measured in terms of: EH&S staff ratios and EH&S expenditures as they relate to the size of the institution and expenditures as they relate to the number of injuries and illness. By adding these additional measurements, a better model could be represented for various EH&S programs.

Another suggestion for future research is to reevaluate the main components of an all-inclusive EH&S programs to see if there are additions or deletions to these components. As noted in the limitations, the study restricted the types of components used and only those components found in the literature search were used to determine the effect on risk of accidents and incidents to institutions. By reexamining EH&S components in more detail, additional findings may indicate that other key components of EH&S programs might have additional effects in promoting safety to prevent potential risk of accidents and incidents to the institutions. By reexamining these components, future studies would be able to extract a greater understanding of what effect the changes in the main components of an all-inclusive EH&S programs have on risk of accidents and incidents to institutions.

Another suggestion for future research direction is to broaden the scope of the study to include a sample of institutions beyond the 2008 CSHEMA Benchmarking Report. In doing so, future results can be better generalized to all research higher education institutions.

Finally, by recognizing that EH&S programs are essential to ensure proper safety to the institution; future longitudinally and qualitatively research could follow up with the emanation of the latest CSHEMA Benchmarking Report to see if the findings are still constant. As noted in the literature review, when colleges and universities are asked to conform to new safety laws, they often do so without specific direction on how to develop and implement their programs. By following up with the CSHEMA Benchmarking Report, future research could determine if the finding are still valid as related to the components that make up an EH&S program, how EH&S programs are organized as related to the number of reporting levels to higher administrations, and EH&S program expenditures and if these are still effective in terms of risk of accidents and incidents to the institution.

5.5 Summary

This study attempted to evaluate EH&S programs and to determine what EH&S programs are comprised of, how they are organized and structured, how they are staffed and funded, and what effect the EH&S programs have on the current level of risk of accidents and incidents in higher education research institutions. The focus of the study has led to the development of model EH&S programs for research colleges and universities based on two types of student population.

This study determined that for research institutions, the staff and funding of EH&S programs have significant impacts on the safe operation of the institution. The study also found that there are two types of organizational structures for EH&S programs: a centralized organizational structure, and a fragmented structure. However, the study found that the EH&S organization structures reporting schemes are not significant in ensuring the safe operation of the institution. Furthermore, the study found for every one million dollar in campus expenditures, the EH&S program will need approximately $2,300 to ensure the safe operation of the institution.

This study offers a comprehensive foundation for additional studies to be conducted in this area of research. Professionals in health and safety, as well as higher education administration professionals, can benefit from this research by gaining a better understanding of EH&S programs for their research higher education institutions.

APPENDIX A

PERMISSION TO USE THE CSHEMA BENCHMARK SURVEY INSTRUMENT QUESTION

Le, Richard

From: Jack Voorhees [jvoorhee@cshema.org]
Sent: Monday, August 31, 2009 10:24 AM
To: Le, Richard
Subject: RE: Permission to use the CSHEMA Benchmark Survey Instrument Question

Richard:

You have our permission to use any of the questions from our benchmarking survey instrument on the condition that you forward an electronic copy of your completed dissertation to CSHEMA to make available to our members.

Good luck with your study!

Jack Voorhees
Executive Director
Campus Safety, Health, and Environmental Management Association
One City Centre, Suite 204
120 W. Seventh St.
Bloomington, IN 47404-3839
812.245.8089 office
812.245.0590 fax
jvoorhee@cshema.org
www.cshema.org

From: Le, Richard [mailto:RLe@admin.fsu.edu]
Sent: Friday, August 28, 2009 10:19 AM
To: JVoorhee@cshema.org
Subject: FW: Permission to use the CSHEMA Benchmark Survey Instrument Question

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From: Le, Richard
Sent: Thursday, August 27, 2009 3:24 PM
To: 'JVoorhee@cshema.org'
Subject: Permission to use the CSHEMA Benchmark Survey Instrument Question

Good afternoon Jack Voorhees, Executive Director of CSHEMA,

It was a pleasure talking to you. To follow up with our phone conversation, I would like to request CSHEMA permission to use the benchmark survey instrument question to be used in my doctoral study.

The benchmark survey instrument question would be used to examine and explore environmental health and safety programs as they relate to college and university size and classification type. For this study the benchmark survey instrument question will help in the determination if the number of components that make up an environmental health and safety program has an effect on minimizing the risks and incidents to the institution. In other words, the two primary research questions for this study are:

- Do college and university size and classification type have an effect on the number of components in an environmental health and safety program?

10/6/2009

- What effect does the number of components in an environmental health and safety program have on minimizing the risks and incidents to the institution?

For the purpose of this study, the components for environmental health and safety programs will be defined as biological, chemical, radiation, laboratory, building code/life safety, fire safety, industrial hygiene, emergency management, and risk management.

Please reply and let me know if I may use the CSHEMA benchmark survey instrument question in my doctoral study.

Best regards,

Richard

Richard N. Le, RBP
Biological Safety Officer
Department of Environmental Health and Safety
Florida State University
Direct: (850) 644-5374
Main Office: (850) 644-6895
FAX: (850) 644-8842
Email: rle@admin.fsu.edu
Website: www.safety.fsu.edu

APPENDIX B

CSHEMA 2008 BENCHMARK AND SALARY SURVEY

DATA COLLECTION TOOL

This document is designed as a tool to help you collect data for completing the 2008 CSHEMA Benchmark and Salary Surveys you are being asked to complete electronically. This tool steps you through collection and documentation of each data element you will be asked to provide. The data elements in this document that will be entered into the online survey are marked with the number of the corresponding online survey question (e.g. BS Q-1, BS Q-2, and etc. for the online benchmarking survey and SS Q-1, SS Q-2, and etc. for the online salary survey).

Survey Data Tool Sections
1.0 Institutional Profile 2.0 General Safety 3.0 Fire Safety 4.0 Biological Safety 5.0 Regulatory Compliance 6.0 Waste Disposal 7.0 Radiation Safety 8.0 Supplemental Questions 9.0 Best Practices 10.0EH&S Salary Survey

1.0 Institutional Profile
There will be many similarities and some differences among the benchmarks calculated from this instrument for research universities, large and small non-research universities/colleges, medical centers, and foreign institutions. The differences are in recognition of the unique operating characteristics and information needs of these five groups. Select the group that best describes your campus even though it may not be an exact fit. As a guideline, a small non-research college/university may have less than 5,000 students, an EH&S staff of approximately 3 or fewer FTE, no satellite campuses, and very little research.

IP 1.0 Institution Type	Answer (BS Q-3):___________________________
1. Research University 2. Large Non-Research College/University 3. Small College/University(fewer than 5,000 students or fewer than 3 EHS FTE) 4. Medical Center 5. Foreign College/University	
IP 1.0 Data Source	
Person Contacted	
Other Info	

Data requested in this section of the survey relate to the institution as a whole and the overall EH&S function. These data will help provide a context for interpreting the results and benchmarks for other institutions, and will also assist you in identifying other institutions that are similar to your own. Some of the data in this section (e.g., student, faculty, and staff FTE) will be used to calculate benchmarks in other areas of the survey. For ease of data collection, we have requested this information only once.

You may need to contact other departments within the institution to collect some of the data requested. For the first six questions, you should obtain the data from your institutional research office or from the person who prepares and submits data to IPEDS. IPEDS, the Integrated Postsecondary Education Data System within the National Center for Education Statistics, is required by the U.S. government for all institutions that receive Title IV financial assistance. Foreign institutions or others who do not submit IPEDS data, please make your best approximation. Because of the timing of the IPEDS reporting cycle, the most recent data will cover FY05-06 for financial data and FY06-07 for enrollment and employee data. If you have access to accurate financial data for FY06-07, feel free to report that instead.

Note: FY06-07 refers to fiscal year July 1, 2006 through June 30, 2007. If you have a different fiscal year that is off by several months, we will accept that data.

IP 1.1 Number of Full-time Equivalent Students (Medical Centers Enter Number of Enrolled Students, Not Visiting Students)	Answer (BS Q-4):
The number of full time equivalent students (undergraduate + graduate + professional) registered at the institution as of October 15, 2007 (or your institution's official fall reporting date). This should be the number reported by your institution to IPEDS. We suggest you contact your office of institutional research for this data.	
IP 1.1 Data Source	
Person Contacted	
Other Info	

IP 1.2 Number of Faculty and Staff
The number of employees in each category as of October 15, 2007 as reported by the institution to IPEDS. We suggest you contact your office of institutional research for this data.

Employee category	**Full time headcount**	**Part time headcount**
With faculty status	(BS Q-5)	(BS Q-6)
Without faculty status (Staff)	(BS Q-7)	(BS Q-8)
Grand total		

IP 1.2 Data Source	
Person Contacted	
Other Info	

IP 1.3 Total Campus Expenditures (Foreign institutions please convert to US dollars)	Answer (BS Q-9):
The institution's total expenditures for FY06-07 (or most recent year available) as reported to IPEDS. We suggest you contact your office of institutional research for this data.	
IP 1.3 Data Source	
Person Contacted	
Other Info	

IP 1.4 Total Campus Research Expenditures (Foreign institutions please convert to US dollars)	Answer (BS Q-10):
All funds expended in FY06-07 (or most recent year available) for research as reported to IPEDS. We suggest you contact your office of institutional research for this data.	
IP 1.4 Data Source	
Person Contacted	
Other Info	

IP 1.5 Total net assignable square feet of all buildings (Foreign institutions please convert to square feet)	Answer (BS Q-11):
The total net assignable square feet (NASF) of all buildings on and off campus that were owned and/or rented by the institution as of October 15, 2007. Include residence halls and non-residence buildings. Include buildings at remote research stations and experimental farms if owned or rented by the institution. Exclude facilities rented to other organizations for their operations. We suggest you contact your office of institutional research for this data.	
IP 1.5 Data Source	
Person Contacted	

Other Info	

IP 1.6 Total net assignable square feet of laboratory space (Foreign institutions please convert to square feet)	Answer (BS Q-12):

The total net assignable square feet (NASF) of laboratory space as of October 15, 2007. This should include all space in room use codes 210 and 250 as defined in the Post-secondary Education Facilities Inventory and Classification Manual used by the National Center for Education Statistics. [Note: If information on assignable square feet is not available, use gross square feet (GSF)]. We suggest you contact your office of institutional research for this data.

IP 1.6 Data Source	
Person Contacted	
Other Info	

IP 1.7 to 1.16 Do the following schools or departments exist at your institution? For each school listed, use a "1" to indicate yes or a "2" to indicate no. (BS Q-13)

IP 1.7 Medical school _______

IP 1.8 Law school _______

IP 1.9 Veterinary school _______

IP 1.10 Dental school _______

IP 1.11 Nursing school _______

IP 1.12 Pharmacology school _______

IP 1.13 Other Health Science schools/departments _______

IP 1.14 Engineering school/department _______

IP 1.15 Agriculture school/department _______

IP 1.16.1 Teaching Hospital excluding Veterinary Hospitals _______

IP 1.16.2 Other: ____

IP 1.17 Number of Patient Days (Medical Centers Only)	Answer (BS Q-14):

If you answered "Yes" to data element IP 1.16, how many in-patient days did the hospital have in FY06-07? If you answered "No" to data element IP 1.16, please respond N/A.

IP 1.17 Data Source	
Person Contacted	
Other Info	

IP 1.18 Number of Out Patient Visits to Clinics (Medical Centers Only)	Answer (BS Q-15):

The number of patient visits to clinics recorded in FY06-07. Include all clinical facilities at remote clinics operated by the medical center.

IP 1.18 Data Source	
Person Contacted	
Other Info	

IP 1.19 Affiliation/Control	Answer (BS Q-16):

Is your institution public, private or a combination?
1. Public
2. Private
3. Combination

IP 1.19 Data Source	
Person Contacted	
Other Info	

IP 1.20 Reporting Line	Answer (BS Q-17):

To whom does the EH&S Director directly report?

1. Administration Vice President/Vice Chancellor
2. Academic Vice President/Vice Chancellor
3. Chancellor/President
4. Administration Associate or Assistant Vice President /Associate or Assistant Vice Chancellor
5. Director of Risk Management
6. Director of Public Safety
7. Director of Facilities
8. Other (please specify)

IP 1.20 Data Source	
Person Contacted	
Other Info	

IP 1.21 Number of Reporting Levels	Answer (BS Q-18):

The number of reporting levels in the institution between the EH&S Director and the institution's President/CEO. For example, if the EH&S Director reports to the Vice President of Administration who reports to the President, your answer would be one.

IP 1.21 Data Source	
Person Contacted	
Other Info	

IP 1.22 Total EH&S Expenditures (Foreign institutions please convert to US dollars)	Answer (BS Q-19):

The total actual expenses incurred by the institution's department of Environmental Health and Safety (see the following list) in FY06-07. Include direct costs such as salaries, benefits, wages, supplies, outsourced, and contracted costs. Exclude extraordinary costs and capital costs. Include only costs that were incurred by the EH&S department.

Overall philosophy of EH&S Services

EH&S primarily provides services related to protecting human health and the environment. Services include: problem identification, hazard assessment, recommendations for administrative controls, engineering controls and personal protective equipment; regulatory compliance reports; and monitoring campus activities for compliance and safe working practices. With the exception of biological, chemical, and radioactive waste management, EH&S programs do not involve much in the way of manual labor.

EH&S Core Programs

1. General and Fire Safety: Occupational safety, industrial hygiene, occupational health and wellness programs, indoor air quality, accident investigation, building inspections for fire and life safety code compliance, building plan reviews
2. Environmental Management: Air permits, water and waste water permits, SPCC plans, underground and above ground tanks, asbestos, lead, food sanitation, FIFRA, EPCRA
3. Biological Safety: Recombinant DNA, biosafety cabinets, review of protocols, select agents, blood borne pathogens, infectious/medical/pathological waste
4. Radiation Safety: Compliance with NRC and/or state regulations, x-ray machines, NORM, laser safety, radioactive waste
5. Chemical Safety/Chemical Waste: Chemical hygiene plans, hazard communication, RCRA, TSCA, DOT shipping

Supplemental Programs

6. Administrative Support: EH&S Director, clerical support, computer support, training support
7. Miscellaneous Programs: emergency response, ergonomics, medical surveillance, etc.

Note: Workers Compensation and Risk Management should not be included when calculating EH&S expenditures.

IP 1.22 Data Source	
Person Contacted	
Other Info	

IP 1.23 EH&S Departmental and Campus Staffing Use the following definitions to provide staffing numbers for EH&S programs in the following table.

FTE means Full-Time Equivalents. A person working four 8-hour days each week is 0.8 FTE.
EH&S FTEs: We suggest you enter numbers to the nearest 0.05 or 0.1, whichever is easier.
Additional campus FTEs: Include only persons who spend at least half their time on EH&S Programs/Functions. Also include outside contractors if you contract for any EH&S services. (e.g. hazardous waste)
Structure: Enter the number for one of the four following "Structure definitions"

Structure definitions:

1. EH&S has sole or primary leadership role
2. EH&S shares leadership with one or more other campus departments
3. EH&S has supportive role, but another campus department has primary leadership role
4. EH&S has little or no role

Program/Function	EH&S FTEs	Additional campus FTEs (optional)	Structure
General Safety	(BS Q-20) 4	(BS Q-21)	(BS Q-22) 1
Fire Safety	(BS Q-23) 7	(BS Q-24)	(BS Q-25) 1
Environmental Mgmt	(BS Q-26)	(BS Q-27)	(BS Q-28) 2
Biological Safety	(BS Q-29) 2	(BS Q-30)	(BS Q-31) 1
Radiation Safety	(BS Q-32) 2	(BS Q-33)	(BS Q-34) 1
Chemical Safety	(BS Q-35) 2	(BS Q-36)	(BS Q-37) 1
Chemical Waste	(BS Q-38) 2	(BS Q-39)	(BS Q-40) 1
Emergency Management	(BS Q-41) 1	(BS Q-42)	(BS Q-43) 1
Occupational Health	(BS Q-44)	(BS Q-45)	(BS Q-46) 2
Administrative Support	(BS Q-47) 7		
Other and Miscellaneous	(BS Q-48) 7		
Totals			

IP 1.23 Data Source	
Person Contacted	
Other Info	

2.0 General Safety	
GS 2.1 Total Reported Injuries and Illnesses	Answer (BS Q-49):

The total number of recordable occupational injuries and illnesses reported by all faculty, staff and student employees of the institution in calendar year 2006. As defined by OSHA, a recordable occupational injury is any injury such as a cut, fracture, sprain, amputation, etc., which results from a work accident or from a single, instantaneous exposure in the work environment. An occupational illness is any abnormal condition or disorder caused by exposure to environmental factors associated with employment. It includes acute and chronic illnesses, and diseases that may be caused by inhalation, absorption, ingestion, or direct contact. This number represents the sum of the entries from columns G, H, I and J of your OSHA 300 Log.

GS 2.1 Data Source	
Person Contacted	
Other Info	

GS 2.2 Lost Workdays	Answer (BS Q-50):
The total number of lost workdays for faculty, staff and student employees of the institution in calendar year 2006 that resulted from occupational injuries and illnesses. As defined by OSHA, lost workdays are those days on which, because of occupational injury or illness, the employee was away from work. The number of lost workdays for faculty, staff, and student employees does not include the day of injury or onset of illness; count the number of calendar days the employee was away from work as a result of injury/illness. Estimate additional lost workdays for claims that remain open. This number represents the total from column K of your OSHA 300 Log.	
GS 2.2 Data Source	
Person Contacted	
Other Info	
GS 2.3 What is your institution's modification factor?	Answer (BS Q-51):
The institution's modification number is determined by the Institution's Worker's Compensation insurance company or, if self-insured, by the institution's Risk Management Office based on past Worker's Compensation loss experience (usually three years). The factor is used to forecast or predict future Worker's Compensation losses and to modify an institution's Worker's Compensation premiums. The modification factor compares an Institution's loss experience with the experience that is expected from other institutions of higher education. A normal or average modification factor is 1.0. Institutions with better than average loss experiences have factors less than 1.0. Your Worker's Compensation Office should have this number readily available.	
GS 2.3 Data Source	
Person Contacted	
Other Info	

3.0 Fire Safety	
FS 3.1 Percentage of Residence Hall space that is sprinklered or covered by other automatic fire suppression systems	Answer (BS Q-52):
The percent of residence halls, dormitories, and apartments (student and faculty housing) that were fully equipped with sprinkler systems or covered by other automatic fire suppression systems as of October 15, 2007. Exclude hotel and conference facilities. Exclude food service.	
FS 3.1 Data Source	
Person Contacted	
Other Info	

4.0 Biological Safety	
BS 4.1 Number of Biosafety Level 3 (BSL-3) Laboratories	Answer(BS Q-53):
The total number of biosafety level 3 and animal biosafety level 3 laboratories in use as of October 15, 2007. If none, enter "0".	
BS 4.1 Data Source	
Person Contacted	
Other Info	
BS 4.2 Number of Biosafety Level 2 (BSL-2) Laboratories	Answer(BS Q-54):
The total number of biosafety level 2 and animal biosafety level 2 laboratories in use as of October 15, 2007. If none, enter "0".	
BS 4.2 Data Source	
Person Contacted	
Other Info	
BS 4.3 Number of protocols reviewed by Institutional Biosafety Committee	Answer (BS Q-55):

The total number of protocols reviewed by the Institutional Biosafety Committee in FY06-07. This should include all recombinant DNA protocols and protocols involving BSL2 or higher work.	
BS 4.3 Data Source	
Person Contacted	
Other Info	

5.0 Regulatory Compliance	
RC 5.1a Total Campus Federal Agency Audits	Answer (BS Q-56):
The total number of compliance inspections conducted in FY06-07 by EPA, NRC, DOT, OSHA, and other federal regulatory agencies.	
RC 5.1a Data Source	
Person Contacted	
Other Info	
RC 5.1b Total Campus State and Local Agency Audits	Answer(BS Q-57):
The total number of compliance inspections conducted in FY06-07 by state and local regulatory agencies.	
RC 5.1b Data Source	
Person Contacted	
Other Info	
RC 5.1c Total number of campus violations from Federal, State, and Local Agency Audits.	Answer (BS Q-58):
The total number of campus violations in FY06-07 resulting from federal, state and local regulatory agencies.	
RC 5.1c Data Source	
Person Contacted	
Other Info	
RC 5.1d Total Cost of Violations (if any from 5.1c).	Answer (BS Q-59):
The total cost of violations from compliance inspections conducted in FY06-07 by federal, state, and local agencies.	
RC 5.1d Data Source	
Person Contacted	
Other Info	

6.0 Waste Disposal	
WS 6.1 Total Pounds of Chemical Waste Shipped to Outside Contractors	Answer (BS Q-60):
The total weight (in pounds) of chemicals that were shipped to outside contractors for treatment, recycling or disposal in FY06-07. Include all chemical waste and solvent-based scintillation fluid. Exclude such wastes as medical, food, biological, radioactive, mixed (radioactive and chemical), asbestos, lead paint, used oil, universal waste and PCBs.	
WS 6.1 Data Source	
Person Contacted	
Other Info	
WS 6.1a For question WS 6.1, how was the weight of labpacks calculated? Choose from choices below.	Answer (BS Q-61):
1. Net weight of chemicals: excludes container weight and excludes all packaging. 2. Weight of chemicals and containers, but excludes all packaging. 3. Gross weight: includes weight of chemicals and containers, and includes all packaging. 4. Other ______________________________	
WS 6.1a Data Source	
Person Contacted	
Other Info	

WS 6.2 Total Institutional Chemical Waste Cost Paid to Outside Contractors (Foreign institutions please convert to US dollars)	Answer (BS Q-62):
The total amount for Chemical Waste treatment, recycling or disposal paid to outside vendors in FY06-07. Exclude extraordinary costs from special projects such as site remediations. Do not include the cost of labor, if you out source the labor to provide services that would normally be provided by EH&S staff.	
WS 6.2 Data Source	
Person Contacted	
Other Info	
WS 6.3 Pounds of Radioactive Waste Removed by Outside Contractors (Foreign institutions please convert to pounds – multiply Kg by 2.2)	Answer (BS Q-63):
The total pounds of radioactive waste removed from the institution by outside contractors in FY06-07. Include both solids and liquids. The reported weight should include containers and all packaging.	
WS 6.3. Data Source	
Person Contacted	
Other Info	
WS 6.4 Total Institutional Radioactive Waste Cost Paid to Outside Contractors (Foreign institutions please convert to US dollars)	Answer (BS Q-64):
The total amount paid to outside vendors for the Radioactive Waste function in FY06-07.	
WS 6.4 Data Source	
Person Contacted	
Other Info	
WS 6.5 Pounds of Biological/Medical Waste Shipped to Outside Vendors (Foreign institutions please convert to pounds – multiply Kg by 2.2)	Answer (BS Q-65)
The total weight (in pounds) of biological/medical waste that was treated or disposed of by outside contractors in FY06-07. Exclude the weight of disposal and shipping containers. Include waste produced by a teaching hospital only if your biological/medical waste staff provides services to teaching hospital. Exclude wastes that are autoclaved on-site and disposed as normal trash by laboratory workers or support staff.	
WS 6.5 Data Source	
Person Contacted	
Other Info	
WS 6.6 Total Institutional Biological/Medical Waste Expenditures Paid to Outside Vendors (Foreign institutions please convert to US dollars)	Answer (BS Q-66)
The total expenditures paid to outside vendors for the Biological/Medical waste function in FY06-07	
WS 6.6 Data Source	
Person Contacted	
Other Info	
WS 6.7 Pounds of Electronic Waste Disposed or Managed by Campus	Answer (BS Q-67)
The total weight (in pounds) of electronic waste (computers, monitors, printers, and other consumer electronic devices) that was managed or disposed of by your campus in FY06-07. Exclude the weight of shipping containers.	
WS 6.7 Data Source	
Person Contacted	
Other Info	

7.0 Radiation Safety	
RS 7.1 Number of Authorized Radiation Users	Answer (BS Q-68):

The total number (headcount) of authorized users of radioactive materials and/or ionizing radiation-producing machines as of October 15, 2007. Authorized users are normally principal investigators who obtain grant funds to conduct radioactive material research. Their applications are usually reviewed and approved by the institution's Radiation Safety Committee.		
RS 7.1 Data Source		
Person Contacted		
Other Info		
RS 7.2 Number of Radiation Workers		Answer (BS Q-69):
The total number of radiation workers (staff, faculty, students, and outside contractors) as of October 15, 2007. Radiation workers are those individuals who work under the supervision of authorized users and who work with any radioisotope and/or radiation producing machine. Exclude occasional visitors.		
RS 7.2 Data Source		
Person Contacted		
Other Info		
RS 7.3 Number of Radioactive Material Packages (Vial/Pig/Source) Received in FY06-07		Answer (BS Q-70):
A package that contains multiple pigs or vials should be considered to be multiple packages.		
RS 7.3 Data Source		
Person Contacted		
Other Info		

8.0 Supplemental Questions
SQ 8.1 Which campus unit/department has primary responsibility for emergency preparedness (preparation of the campus emergency plan, planning drills, etc.)? (BS Q-71): 1. EH&S 2. Campus Police 3. Physical Plant 4. Risk Management 5. Other (specify)________________________________
SQ 8.2 Does your campus have one or more full-time staff whose primary responsibility is emergency preparedness? Answer (BS Q-72): ___________ (1=Yes, 2=No)
SQ 8.3 Does your campus have an Environmental Management System? Answer (BS Q-73): ___________ (1=Yes, 2=No)
SQ 8.3a If you answered yes, what kind of Environmental Management System do you have? Answer (BS Q-74): ___________ 1. ISO 14001 compliant 2. Participation in EPA National Performance Track or comparable state program 3. Environmental Management System developed in-house with some outside audits 4. Environmental Management System developed in-house with no outside audits Other (please describe)____
SQ 8.4 Does your campus have an active sustainability initiative? (A campus committee or task force; measurement of the environmental impacts of campus activities; an annual environmental/sustainability report; etc.) Answer (BS Q-75): ___________ (1=Yes, 2=No)
SQ 8.4.5 If yes, which department is leading the effort? Answer (BS Q-76): ____ ____

SQ 8.5 How is your hazardous waste program funded?
Answer (BS Q-77): ________________
1 = Waste generator pays (EH&S recharges waste generator for cost of hazardous waste disposal)
2 = EH&S pays (EH&S budget funds pay for campus hazardous waste disposal)
3 = Other ____
____

9.0 Best Practices

BP 9.0 We are interested in sharing examples of best practices with survey participants. If your campus has implemented a successful best practice that you would like to share, please list it below:

Example Best Practice: Title: Learning Management System (LMS) to track safety training.
Summary: We utilize an LMS that is a full service training web program. Employees utilize the LMS to self identify required and recommended safety training. Employees can register for classroom training and take online training using the LMS. A comprehensive training transcript is maintained. The employee's supervisor can oversee all this activity.

Best Practice #1. Title (BS Q-78): ____
____
____
Summary (BS Q-79):____
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Best Practice #2. Title (BS Q-80):____
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Summary (BS Q-81):____
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Best Practice #3. Title (BS Q-82):____
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Summary (BS Q-83):____
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____

Best Practice #4. Title (BS Q-84):____ ____ ____ **Summary** (BS Q-85):____ ____ ____ ____ ____ ____ ____

This section of the tool should be used to collect data for the CSHEMA 2008 Salary Survey

10.0 EH&S Salary Survey – Cost of Living Index	
Cost of Living Index Different states and urban areas of the United States, as well as other countries, have a different cost of living. Please utilize the Cost of Living Index Summary available on the CSHEMA Benchmarking Data Collection Web page at XXXX to identify the cost of living index for your state and urban area (best fit) and report it below:	
10.0.1 Best fit urban area and state from summary: Answer (SS Q-3): ____	
10.0.2 Cost of living index (usually a number between 50 and 200) for my location: Answer (SS Q-4): ____	
10.1 EH&S Salary Survey – Job Title/Salary	
For the purposes of this survey, a "small institution" is one with fewer than 5,000 students or fewer than 3 EHS FTE. Campuses with medical or veterinary centers, substantial graduate programs, or substantial research programs are probably not "small."	
10.1.0 Given the guidance above, do you consider your institution to be "small," if only for the purposes of this survey? Answer (SS Q-5): ___ YES ___ NO	
Generic Job Title	**Description**
EH&S Director	Most senior EH&S professional. Typically serves as the liaison with senior administration. Has complete responsibility for the operations of all areas within EH&S. Has primary budget responsibilities for all areas within EH&S.
EH&S Assistant/ Associate Director	Reports to the Director of EH&S. May oversee multiple EH&S programs and staff. Primary responsibilities are programmatic (i.e., not business related). Is generally located above program managers in an organizational chart.
Program Manager	Reports to the Director or an Assistant/Associate Director. Manages one or more technical programs. May have supervisory responsibilities.
Professional Staff	Has problem-solving responsibilities. Is self-directed in his/her work. Often has academic training.
Technician	Has routine, defined duties. Typically works in the field. Generally has on-the-job training. Often paid hourly.
NOTE: Small schools will fill out the EH&S Director and the following two classifications only.	
EH&S Specialist (small school)	Reports to EH&S Director or Director overseeing EH&S programs. May serve as Radiation Safety Officer, Biosafety Officer and/or Chemical Hygiene Officer. Responsibilities may include designing, developing, and implementing procedures for a wide variety of EH&S programs. Often supervises technicians, if any.
EH&S Technician (small school)	Provides a broad spectrum of technical support to EH&S programs. Often performs routine monitoring, routine testing of safety equipment and waste collection.

Salary Report the actual annual salary or wages as of October 1, 2007. Exclude overtime pay and the value of all benefits. If a person works part-time, please record the amount they would have been paid if they worked full-time (assume the same rate of pay). Note: the sum of the salaries recorded in this column is not expected to equal the total labor costs of the EH&S function.
Education Enter the number below that corresponds with the highest degree earned. 1. Less than Bachelors 3. Masters 2. Bachelors 4. Ph.D./J.D., or other Doctorate
Years Experience Enter the number below that corresponds with the number of years of environmental, health and safety experience as of October 1, 2007. If EH&S responsibilities were not full-time, include an estimate based on percent of total responsibilities. 1. 0 - 5 years 2. 6 - 10 years 5. 21 or more years 3. 11 - 15 years 4. 16 - 20 years
Note: If you have more than three staff in any single position, enter data for the lowest paid, highest paid, and the one in the middle. We have adopted this policy to avoid having salaries at certain programs from being overrepresented.

Small Schools Only
(fewer than 5,000 students or fewer than 3 EHS FTE)

Data Entry in White Cells

Job Title		**Annual Salary/Wages Indicate Full-Time Pay**	**1=<BS 2=BS 3=Master 4=PhD/JD**	***Years Experience*** **1=0-5; 2=6-10; 3=11-15; 4=16-20; 5=21 or more**
10.1.1	EH&S Director	(SS Q-6)	(SS Q-7)	(SS Q-8)
10.2a.1	EH&S Specialist (High pay rate)	(SS Q-9)	(SS Q-10)	(SS Q-11)
10.2a.2	EH&S Specialist (Mid pay rate)	(SS Q-12)	(SS Q-13)	(SS Q-14)
10.2a.3	EH&S Specialist (Low pay rate)	(SS Q-15)	(SS Q-16)	(SS Q-17)
10.3a.1	EH&S Technician (High pay rate)	(SS Q-18)	(SS Q-19)	(SS Q-20)
10.3a.2	EH&S Technician (Mid pay rate)	(SS Q-21)	(SS Q-22)	(SS Q-23)
10.3a.3	EH&S Technician (Low pay rate)	(SS Q-24)	(SS Q-25)	(SS Q-26)

LARGER SCHOOLS

Data Entry in White Cells

Job Title		**Annual Salary/Wages Indicate Full-Time Pay**	**1=<BS 2=BS 3=Master 4=PhD/JD**	***Years Experience*** **1=0-5; 2=6-10; 3=11-15; 4=16-20; 5=21 or more**
10.1.1	EH&S Director	(SS Q-27)	(SS Q-28)	(SS Q-29)

10.2.1	EH&S Assistant/Associate Director (Highest pay rate)	(SS Q-30)	(SS Q-31)	(SS Q-32)
10.2.2	EH&S Assistant/Associate Director (Mid pay rate)	(SS Q-33)	(SS Q-34)	(SS Q-35)
10.2.3	EH&S Assistant/Associate Director (Lowest pay rate)	(SS Q-36)	(SS Q-37)	(SS Q-38)
10.3.1	Fire Safety Program Manager	(SS Q-39)	(SS Q-40)	(SS Q-41)
10.4.1	Fire Safety Professional Staff (Highest pay rate)	(SS Q-42)	(SS Q-43)	(SS Q-44)
10.4.2	Fire Safety Professional Staff (Mid pay rate)	(SS Q-45)	(SS Q-46)	(SS Q-47)
10.4.3	Fire Safety Professional Staff (Lowest pay rate)	(SS Q-48)	(SS Q-49)	(SS Q-50)
10.5.1	Fire Safety Technician (Highest pay rate)	(SS Q-51)	(SS Q-52)	(SS Q-53)
10.5.2	Fire Safety Technician (Mid pay rate)	(SS Q-54)	(SS Q-55)	(SS Q-56)
10.5.3	Fire Safety Technician (Lowest pay rate)	(SS Q-57)	(SS Q-58)	(SS Q-59)
10.6.1	Hazardous Waste Program Manager	(SS Q-60)	(SS Q-61)	(SS Q-62)
10.7.1	Hazardous Waste Professional Staff (Highest pay rate)	(SS Q-63)	(SS Q-64)	(SS Q-65)
10.7.2	Hazardous Waste Professional Staff (Mid pay rate)	(SS Q-66)	(SS Q-67)	(SS Q-68)
10.7.3	Hazardous Waste Professional Staff (Lowest pay rate)	(SS Q-69)	(SS Q-70)	(SS Q-71)
10.8.1	Hazardous Waste Technician (Highest pay rate)	(SS Q-72)	(SS Q-73)	(SS Q-74)
10.8.2	Hazardous Waste Technician (Mid pay rate)	(SS Q-75)	(SS Q-76)	(SS Q-77)
10.8.3	Hazardous Waste Technician (Lowest pay rate)	(SS Q-78)	(SS Q-79)	(SS Q-80)

10.9.1	Chemical & Laboratory Safety Program Manager	(SS Q-81)	(SS Q-82)	(SS Q-83)
10.10.1	Chemical & Laboratory Safety Professional Staff (High pay rate)	(SS Q-84)	(SS Q-85)	(SS Q-86)
10.10.2	Chemical & Laboratory Safety Professional Staff (Mid pay rate)	(SS Q-87)	(SS Q-88)	(SS Q-89)
10.10.3	Chemical & Laboratory Safety Professional Staff (Low pay rate)	(SS Q-90)	(SS Q-91)	(SS Q-92)
10.11.1	Chemical & Laboratory Safety Technician (Highest pay rate)	(SS Q-93)	(SS Q-94)	(SS Q-95)
10.11.2	Chemical & Laboratory Safety Technician (Mid pay rate)	(SS Q-96)	(SS Q-97)	(SS Q-98)
10.11.3	Chemical & Laboratory Safety Technician (Lowest pay rate)	(SS Q-99)	(SS Q-100)	(SS Q-101)
10.12.1	Environmental Issues Program Manager	(SS Q-102)	(SS Q-103)	(SS Q-104)
10.13.1	Environmental Issues Professional Staff (Highest pay rate)	(SS Q-105)	(SS Q-106)	(SS Q-107)
10.13.2	Environmental Issues Professional Staff (Mid pay rate)	(SS Q-108)	(SS Q-109)	(SS Q-110)
10.13.3	Environmental Issues Professional Staff (Lowest pay rate)	(SS Q-111)	(SS Q-112)	(SS Q-113)
10.14.1	Environmental Issues Technician (Highest pay rate)	(SS Q-114)	(SS Q-115)	(SS Q-116)
10.14.2	Environmental Issues Technician (Mid pay rate)	(SS Q-117)	(SS Q-118)	(SS Q-119)
10.14.3	Environmental Issues Technician (Lowest pay rate)	(SS Q-120)	(SS Q-121)	(SS Q-122)
10.15.0	Biosafety Program Manager	(SS Q-123)	(SS Q-124)	(SS Q-125)
10.15.1	Biosafety Professional Staff (Highest pay rate)	(SS Q-126)	(SS Q-127)	(SS Q-128)
10.15.2	Biosafety Professional Staff	(SS Q-129)	(SS Q-130)	(SS Q-131)

	(Mid pay rate)			
10.15.3	Biosafety Professional Staff (Lowest pay rate)	(SS Q-132)	(SS Q-133)	(SS Q-134)
10.16.1	Biosafety Technician (Highest pay rate)	(SS Q-135)	(SS Q-136)	(SS Q-137)
10.16.2	Biosafety Technician (Mid pay rate)	(SS Q-138)	(SS Q-139)	(SS Q-140)
10.16.3	Biosafety Technician (Lowest pay rate)	(SS Q-141)	(SS Q-142)	(SS Q-143)
10.17.1	Environmental Health/Sanitation Program Manager	(SS Q-144)	(SS Q-145)	(SS Q-146)
10.18.1	Environmental Health/Sanitation Professional Staff (Highest pay rate)	(SS Q-147)	(SS Q-148)	(SS Q-149)
10.18.2	Environmental Health/Sanitation Professional Staff (Mid pay rate)	(SS Q-150)	(SS Q-151)	(SS Q-152)
10.18.3	Environmental Health/Sanitation Professional Staff (Lowest pay rate)	(SS Q-153)	(SS Q-154)	(SS Q-155)
10.19.1	Environmental Health/Sanitation Technician (Highest pay rate)	(SS Q-156)	(SS Q-157)	(SS Q-158)
10.19.2	Environmental Health/Sanitation Technician (Mid pay rate)	(SS Q-159)	(SS Q-160)	(SS Q-161)
10.19.3	Environmental Health/Sanitation Technician (Lowest pay rate)	(SS Q-162)	(SS Q-163)	(SS Q-164)
10.20.1	General Safety Program Manager	(SS Q-165)	(SS Q-166)	(SS Q-167)
10.21.1	General Safety Professional Staff (Highest pay rate)	(SS Q-168)	(SS Q-169)	(SS Q-170)
10.21.2	General Safety Professional Staff (Mid pay rate)	(SS Q-171)	(SS Q-172)	(SS Q-173)
10.21.3	General Safety Professional Staff (Lowest pay rate)	(SS Q-174)	(SS Q-175)	(SS Q-176)
10.22.1	General Safety Technician (Highest pay rate)	(SS Q-177)	(SS Q-178)	(SS Q-179)

10.22.2	General Safety Technician (Mid pay rate)	(SS Q-180)	(SS Q-181)	(SS Q-182)
10.22.3	General Safety Technician (Lowest pay rate)	(SS Q-183)	(SS Q-184)	(SS Q-185)
10.23.1	Radiation Safety Officer Program Manager	(SS Q-186)	(SS Q-187)	(SS Q-188)
10.24.1	Health Physics/Radiation Safety Professional Staff (Highest pay rate)	(SS Q-189)	(SS Q-190)	(SS Q-191)
10.24.2	Health Physics/Radiation Safety Professional Staff (Mid pay rate)	(SS Q-192)	(SS Q-193)	(SS Q-194)
10.24.3	Health Physics/Radiation Safety Professional Staff (Lowest pay rate)	(SS Q-195)	(SS Q-196)	(SS Q-197)
10.25.1	Health Physics/Radiation Safety Technician (Highest pay rate)	(SS Q-198)	(SS Q-199)	(SS Q-200)
10.25.2	Health Physics/Radiation Safety Technician (Mid pay rate)	(SS Q-201)	(SS Q-202)	(SS Q-203)
10.25.3	Health Physics/Radiation Safety Technician (Lowest pay rate)	(SS Q-204)	(SS Q-205)	(SS Q-206)
10.26.1	Industrial Hygiene Program Manager	(SS Q-207)	(SS Q-208)	(SS Q-209)
10.27.1	Industrial Hygiene Professional Staff (Highest pay rate)	(SS Q-210)	(SS Q-211)	(SS Q-212)
10.27.2	Industrial Hygiene Professional Staff (Mid pay rate)	(SS Q-213)	(SS Q-214)	(SS Q-215)
10.27.3	Industrial Hygiene Professional Staff (Lowest pay rate)	(SS Q-216)	(SS Q-217)	(SS Q-218)
10.28.1	Industrial Hygiene Technician (Highest pay rate)	(SS Q-219)	(SS Q-220)	(SS Q-221)
10.28.2	Industrial Hygiene Technician (Mid pay rate)	(SS Q-222)	(SS Q-223)	(SS Q-224)
10.28.3	Industrial Hygiene Technician (Lowest pay rate)	(SS Q-225)	(SS Q-226)	(SS Q-227)

10.29.1	Emergency Response/Disaster Preparedness Program Manager	(SS Q-228)	(SS Q-229)	(SS Q-230)
10.30.1	Emergency Response/Disaster Preparedness Professional Staff (Highest pay rate)	(SS Q-231)	(SS Q-232)	(SS Q-233)
10.30.2	Emergency Response/Disaster Preparedness Professional Staff (Mid pay rate)	(SS Q-234)	(SS Q-235)	(SS Q-236)
10.30.3	Emergency Response/Disaster Preparedness Professional Staff (Lowest pay rate)	(SS Q-237)	(SS Q-238)	(SS Q-239)
10.31.1	Emergency Response/Disaster Preparedness Technician (Highest pay rate)	(SS Q-240)	(SS Q-241)	(SS Q-242)
10.31.2	Emergency Response/Disaster Preparedness Technician (Mid pay rate)	(SS Q-243)	(SS Q-244)	(SS Q-245)
10.31.3	Emergency Response/Disaster Preparedness Technician (Lowest pay rate)	(SS Q-246)	(SS Q-247)	(SS Q-248)
10.32.1	Asbestos and Lead Program Manager	(SS Q-249)	(SS Q-250)	(SS Q-251)
10.33.1	Asbestos and Lead Professional Staff (Highest pay rate)	(SS Q-252)	(SS Q-253)	(SS Q-254)
10.33.2	Asbestos and Lead Professional Staff (Mid pay rate)	(SS Q-255)	(SS Q-256)	(SS Q-257)
10.33.3	Asbestos and Lead Professional Staff (Lowest pay rate)	(SS Q-258)	(SS Q-259)	(SS Q-260)
10.34.1	Asbestos and Lead Technician (Highest pay rate)	(SS Q-261)	(SS Q-262)	(SS Q-263)
10.34.2	Asbestos and Lead Technician (Mid pay rate)	(SS Q-264)	(SS Q-265)	(SS Q-266)
10.34.3	Asbestos and Lead Technician (Lowest pay rate)	(SS Q-267)	(SS Q-268)	(SS Q-269)
10.35.1	Occupational Health Program Manager	(SS Q-270)	(SS Q-271)	(SS Q-272)
10.36.1	Occupational Health Professional Staff (Highest pay rate)	(SS Q-273)	(SS Q-274)	(SS Q-275)
10.36.2	Occupational Health Professional Staff (Mid pay rate)	(SS Q-276)	(SS Q-277)	(SS Q-278)

10.36.3	Occupational Health Professional Staff (Lowest pay rate)	(SS Q-279)	(SS Q-280)	(SS Q-281)
10.37.1	Occupational Health Technician (Highest pay rate)	(SS Q-282)	(SS Q-283)	(SS Q-284)
10.37.2	Occupational Health Technician (Mid pay rate)	(SS Q-285)	(SS Q-286)	(SS Q-287)
10.37.3	Occupational Health Technician (Lowest pay rate)	(SS Q-288)	(SS Q-289)	(SS Q-290)

Thank you for participating in the

2008 CSHEMA Benchmark and Salary Surveys!

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BIOGRAPHICAL SKETCH

An only child, Richard Ngoc Le was born in Saigon, South Vietnam. As a refugee, in 1980 he and his parents came to the United States and settled in Fort Myers Florida. He graduated from Riverdale High School in 1991 with honors and subsequently attended The Florida State University (FSU). He received Bachelor of Science degrees in Biology, Chemistry and Biochemistry from FSU in 1996. In 2002, Richard completed a Master degree in Public Administration from the Reubin O'd Askew School of Public Administration and Policy at FSU. Richard began his doctoral coursework at FSU as a special student and in 2005, officially enrolled as a doctoral student in the Educational Leadership and Policy Studies program while working full time at FSU. On June 27th, 2011, he successfully defended his doctoral dissertation.

Richard has worked in the health and safety field for over twelve years. He began his work in this field as a Health Physicist for the Florida Bureau of Radiation Control and Emory University. He currently serves as Florida State University's Biological Safety Officer in the FSU Department of Environmental Health and Safety.

Richard's research interests include the efficacy of health and safety programs in higher education. He currently has two publications in this field: "One university's approach to controlling potential exposures to animal allergens in biomedical research" published in *Journal of Chemical Health & Safety* and "Autoclave testing in a university setting" published in the *Applied Biosafety, Journal of the American Biosafety Association Education*.