Activity Hazard Analysis in a Marine

Construction Environment

by

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Abstract

In Company XYZ, the absence of a streamlined and structured process for Activity Hazard Analyses (AHA) has the potential to lead to a decrease in productivity, poor hazard identification and control, and could cause the analysis to be underutilized as an important safety tool. Establishing an efficient AHA program will assist in the identification, assessment and communication of risk, with the ultimate goal of eliminating unnecessary hazardous exposures. This study compared a sample of current AHA documents to the industry best practices, as well as gathering information in a meeting with current employees having experience with the AHA program. The research results identified key efficiencies and deficiencies in Company XYZ's current program. The efficiencies indicated that the program has strong management support, employees have easy access to updated AHA's, and that they use a group method to identify the steps and potential risks. These efficient practices would be beneficial for any company to consider in their hazard analysis program. The data also identifies key deficiencies in the current

program which was the main objective of the study. The data shows that a small percentage of AHA's needed work to improve clarity of job steps and to better identify all potential hazards and controls. This is an important step in order to accurately define all risks during the work activity. The recommendations of this study are to implement a number of administrative controls that will assist in the identification of hazards and measurement of the program success leading to an overall reduction in unidentified risks.

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Chapter I: Introduction

In the marine construction industry, safety managers are faced with the task of developing and implementing Activity Hazard Analyses (AHA) for operational processes. When a new job is to be performed, this analysis identifies the step by step process, the hazards and risks that may occur and the established controls to reduce those risks. This analysis also contains information regarding equipment, training requirements, and inspection requirements. Company XYZ marine contractor is required by most of their customers to develop an AHA for each change in work activity. The company is a full service marine contractor performing various operations around the United States. Some of the tasks which they perform are dredging and dewatering, dam and bridge rehabilitation and marine construction. They currently employ a safety director and three site safety managers. The number of regular full time employees can vary depending on the current worksites, season and the particular scope of work.

Throughout the many processes that this company performs, AHA's are repeated, but often need to be redeveloped for each site because of the lack of an efficient documenting system. The site manager's work with foremen to discuss the process and determine the hazards before a task is started. This can result in a hurried analysis process and in turn lead to reduced quality. Without the proper process for assessing and controlling risks, there is a potential for unnecessary accidents over time. With the ever-changing conditions of the marine construction environment, it is important to analyze each individual scenario before work is performed, taking into consideration any unique factors. Many companies require an AHA to be prepared before a work activity can begin, but there are no firm guidelines as to how this is to be accomplished. According to Palmer (2004), hazard analyses are often completed only on the basis of meeting a regulatory requirement. The true purpose and intent is often overlooked, and companies are unable to utilize the information gathered in order to identify new or existing hazards. This presents a problem in addressing how a company can be certain that all issues are identified and what might happen if changes in procedures are needed while work is being accomplished.

Statement of Problem

In XYZ Company, the absence of a streamlined and structured process for using Activity Hazard Analyses leads to a decrease in productivity, the potential for poor hazard analysis, and could cause the AHA to be underutilized as an important safety tool.

Purpose of Study

The purpose of this paper is to define an adequate and efficient AHA process to be used in the marine construction industry. This AHA can be used as a tool for future safety managers and will be centered on assessing and reducing risk for marine construction activities.

Significance of Study

The implementation of an AHA program as a safety tool can provide efficient hazard assessments and establish controls for risk while reducing or eliminating unnecessary losses. This will also be useful in continued safe procedure training for new and existing employees. The training of personnel and updating of procedures is important in identifying the risks of the marine construction industry. Setting guidelines for AHA's will assist managers in their communication of potential hazards and employees will be able to identify and adjust these forms as new hazards develop. This study may lend information to determine a need for changes in marine construction procedures as they relate to engineering or administrative controls. Many managers are not aware of the potential benefits that quality AHA's can provide when implemented as part of a complete strategy. Lost time and productivity can be attributed to the fact that managers may, on occasion, need to stop work to re-evaluate a process where an AHA was previously prepared, but is currently unavailable at the worksite.

Assumptions of Study

1. The primary assumption of this study is that the marine construction industry will continue to implement AHA's as a part of their risk analysis procedures.

2. This study is not intended to redesign the already established form of an AHA.

Definition of Terms

Activity Hazard Analysis (AHA) – Form used to identify risks associated with each step of a job procedure and the controls that are in place to manage those risks.

Marine Construction Industry – Field as a whole representing the intersection of construction projects performed in a marine or water environment.

USACE – United States Army Corps of Engineers

Limitations of Study

1.) The investigator's experience is limited to one company and may not necessarily be generalized to the marine construction industry as a whole.

2.) The investigator was exploring this issue for a limited amount of time, three months as an Intern.

Methodology

The investigator used current research available on this topic from various sources and synthesized relevant literature to establish best practices regarding hazard assessment and control for Company XYZ. The companies existing process was reviewed and documented using a sample case. Then the author used the analysis to develop a new system with recommendations for developing an effective AHA program.

Chapter II: Literature Review

This chapter will review the current research relevant to Activity Hazard Analysis. The purpose was to identify the current research trends and discuss many industry best practices for hazard analysis. This topic of study in the research is often referred to as process hazard analysis, job hazard analysis, or job safety analysis. Information will be presented regarding the background of AHA's. Also, the review offers insight into how to develop and manage a hazard analysis program. Literature will then be reviewed regarding the effectiveness of AHA programs, and what benefits may arise from implementation. To understand AHA, the literature review identifies the key objectives that focus on hazard analysis as a whole. While this study's focus is primarily on hazard analysis in the marine construction industry, it will also be important to integrate information from both general construction and manufacturing industries that offer related processes.

Background information for AHA's

In the Safety and Health Requirements manual issued by the U.S. Army Corps of Engineers (USACE) (2008), the activity hazard analysis process is identified as a requirement for all contractors performing work on USACE sites. The content and objectives of the analyses are stated as an opportunity to identify new job tasks, their potential hazards and the controls used to minimize loss. Reference should also be made to the equipment being used in the activity, the inspection requirements, and the training requirements for personnel. These completed documents will then be reviewed by USACE personnel and discussed with the contractor before the activity begins. On USACE work sites, the contractor must provide a competent person to act as the site safety officer while all work is performed. That person conducts safety meetings on a regular basis to identify key issues to current operations and review the relevant information provided by the AHA's. In the broad field of construction, many projects do not require a hazard analysis before work is performed. The lack of this process can often lead to a potential for unidentified risks on the worksite. The USACE acknowledges that AHA's can be a very important tool for contractors in the identification and control of assumed risks. Therefore, regulations are in place to ensure that all contractors complete an AHA before work is performed.

Overview of the Army Safety Program

According to the Department of the Army (2010), the use of an AHA is an important component to their overall safety management program contained in the Army safety program manual. The Army has established effective standards for conducting work activities at the lowest possible risk level, while protecting workers, the environment and the surrounding communities. They have created a six step system safety process that may be important in conducting an AHA program. The first step is to plan the program and identify the people, processes and equipment that may be significant. Step two is to identify and assess the potential hazards in order to implement controls to minimize risks. Step three is to develop a process for tracking hazards and a follow-up corrective action plan. Step four is to evaluate the potential effects of the identified hazards with use of a risk matrix, which will be identified later in this chapter. Step five is to prioritize and track the hazards based on likelihood and severity. The final step is to manage the process and relay information to management on the status of hazard controls and track corrective action plans.

There are many tools that the Department of the Army (2010) suggests can be used in this type of safety program. An AHA is one that can be very beneficial in the process. The AHA plays a critical role in this process, and is a requirement for the contractual work with the department. The Army also requires a site specific safety plan for any contractor that will become the basis the overall commitment to a safe environment. The Army acknowledges that the simple AHA document is not sufficient for the safety plan, but regular health and safety inspections with the use of this document can identify whether the safety standards are being accomplished. Using the AHA in the inspection process can help identify any deficiencies in the document and may lead to corrective action plans. Corrective action plans should establish both long-term and short-term goals in order to effectively track changes in processes or equipment while eliminating, controlling or reducing hazardous exposures. This is why it may be important to establish a set of guidelines for inspection that will continually monitor the safety and health program.

Components of a Hazard Analysis

OSHA (2002) suggests that a hazard analysis program is one of the best components of a safety program to identify and control risks. OSHA states the following five main questions that should be answered when preparing an AHA. The preparer should inquire about what could go wrong, what are the consequences, how could it happen, what are the contributing factors and how likely is it that the hazard will occur. Once these questions have been answered the preparer should determine what types of controls will be used to eliminate or reduce the risks. There are three main options to consider in the following sequence. The uses of engineering controls that will eliminate, enclose, isolate or remove the hazard from the task. If this is not possible, administrative controls such as written procedures, exposure limitations, hazardous material monitoring, warning devices or training should be considered. The last option that should be considered is the use of personal protective equipment. This should only be a consideration if all other controls are not feasible for the specific situation.

According to Smith and Whittle (2001), process hazard management programs are a requirement in many industries. However, the construction industry lacks any regulations for the development and implementation of these types of control programs. The model of hazard management is relevant for most industries, but will change based on regulations, standards, or internal programs. In the construction industry, the relevant issues for AHA stem from the changing environment for identifying and managing risks. Some of the factors that contribute to exposure level in the construction industry include: changes in weather conditions, job rotations, temporary or inexperienced employees, geography, and other working conditions. This variety of factors makes the AHA process more difficult in comparison to a manufacturing facility. Therefore, while hazard analysis techniques can be taken from other industries, they need to be modified to fit the construction business (Rozenfeld, Sacks, Rosenfeld, & Baum, 2010).

Categories of Hazards

It is important to consider all categories of hazards when planning the analysis process. Morris (2003) identifies five categories of hazards that should be recognized. The first type of hazard is chemical, which reflects information regarding effects on a person's health, flammability potential and reactive capabilities. Secondly, biological hazards are those associated with the exposure to viruses, fungi, mold or bacteria. Third are the physical hazards associated with temperature extremes, noise, electrical energy, or vibration. The fourth is psychosocial hazard relating to exposure to nature, organizational culture, management style, and content of the job. The fifth is associated with mechanical hazards resulting in stress on the body. It is important to consider each of these categories in order to clearly identify the hazard and establish controls to prevent or minimize their occurrence.

According to Swartz (2002), to follow in the industry best practices for AHA's, there are a number of key hazardous conditions that must be identified. During every step of the job task, each of the eleven following hazards should be considered: struck by, struck against, caught between, contact with, contacted by, caught in, caught on, fall from same level, fall to below, overexertion, and exposure. In some cases, different industries may have additional hazards that must be identified. These factors should be used in the pre-inspection process of the jobsite to identify and correct any unsafe conditions. Swartz also believes that this information can be useful to train employees in the identification of hazards. The employee's knowledge of these exposures will likely reduce the potential for any unsafe behaviors that may result in injury.

Managing the AHA Process

Swartz (2002) identifies the four key objectives to obtaining a quality and successful AHA process. First is the ability to obtain the support of the management team in producing a program that will encompass all facets of business. The second objective stems from a need to train supervisors and employees in providing accurate information regarding job tasks and assignments. The third step is a written program that will define the objectives and standards, as well as any relevant information regarding preparation, documentation and use of hazard analyses. The fourth objective is to appoint personnel that will direct the objectives of the program. This individual will be trained to manage the hazard analysis assignments of all personnel, making sure quality reports are recorded and tasks are not repeated. The results of a quality AHA program could help inform the management on three key areas. The first will help predict the need for regular inspection and maintenance to reduce hazards. Secondly, employees trained in the AHA process will be able identify and eliminate potential hazards before an injury occurs. The last function will be to adequately assess hazards and improve controls, allowing for the safest work environment for employees.

Swartz (2002) also suggests four techniques that can be used to prepare an AHA. The first is a one on one observation performed by a trained individual who documents the important steps of a process. This allows the employees to give feedback and suggestions towards the improvements needed or the location of possible hazards. The second technique is performed by a group of individuals that will analyze a process in a classroom. This method allows for quality discussion about key hazardous exposures. The third technique is performed by a supervisor attempting to recall the steps of the process. After completion of the AHA, the supervisor will reference the steps with the worker performing the task to identify that all steps are considered. The last method is often the least effective and is conducted without observation or discussion of the process with other personnel; this is also referred to as the absentee method (Swartz, 2002) and will be discussed later in this chapter. It is important to acknowledge the effectiveness of each technique in order to apply the appropriate method to the companies program.

Once a quality AHA has been prepared, the next important step is to continually monitor the document to make appropriate updates and changes. Smith and Whittle (2001) outlined six important steps to update and revalidate AHA's. This article reflects a common problem in organizations where the proper documentation of hazard analysis is not occurring. Many companies struggle with not utilizing their resources to effectively update hazard analyses. This can lead to an increased opportunity for losses. The authors assert that the following six steps should be taken to accurately update and revalidate AHA's. The first step is to review all modifications made to the process since the previous AHA. Step two includes reviewing the previous incidents. Step three includes reviewing the status or resolution of previous AHA recommendations. Step four is to update the human factors or facility and stationary source citing analyses. The fifth step is to address hazards associated with non-routine operating modes. The last step is to ensure that the AHA meets the requirements of any existing or new regulations, industry standards or internal company requirements. This article presents a comprehensive guide to maintaining an effective AHA program, although the actual approach will vary from one revalidation to the next.

The six step process is important to understand in order to implement a systematic approach to updating or revalidating current AHA's. According to Smith and Whittle (2001), there are many key objectives of this program that can be taken from the literature that will help establish effective hazard analyses. The review of previous updates on AHA's or processes is important to effectively ensure whether the recommendations for improvements were relevant or irrelevant. This means that previous issues may or may not have been accurately implemented and need to be corrected. Also, it can be helpful to develop a system to document "near misses" in order to identify the potential exposures that may not have previously been recognized. This process can be especially important in addressing non-routine jobs. Smith and Whittle identify that many of the human errors are the result of non-routine operation and therefore it is important to accurately assess all potential tasks in order to manage risk effectively. This is an example of how this documentation can become an important tool for adequate safety training for employees. According to Bancroft (2002), the review process is a key step that should not be overlooked. When changes have been made to a process or an AHA document, the modifications should be studied in order to determine the accuracy or sufficiency of the controls.

Using a Risk Matrix

Another factor that may be helpful in an AHA would be to associate a risk scoring system into each task in order to evaluate to risk exposures. Geronsin (2001) indicates that the use of a risk assessment matrix can be an important tool to identify the probability and severity of an apparent risk. This analysis allows both management and the employees to understand the extent of potential risks of each task and the importance of the controls in place used to reduce or eliminate the risk. This process is not often a necessity in an AHA, but is useful in evaluating the extent of the risk. The information can then be used to identify what risks can benefit from controls and what high risk exposures should be eliminated.

According to Clemens and Pfitzer (2006), the risk matrix is an important tool in guiding management's decisions for accepting or rejecting identified risks. In most cases, hazard analyses are recorded for individual tasks and not as a whole system. The acceptability of risk is then only evaluated by that specific task and possibly not the entire process. The authors identify the need to calculate the sum of the risks for a particular scenario in order to accurately control the hazards. The risk levels may be acceptable on an individual basis, but as a whole, the risks may be too large to accept. Often times the sum of the hazards can increase the probability or severity of an incident occurring. It is important then that persons responsible for this program understand the differences between the individual risks and the risks as a whole project. This has the potential to benefit any company by reducing the overall costs of risks.

The risk assessment matrix can be an effective tool, but it is often difficult to accurately justify in a construction environment. Rozenfeld, Sacks, Rosenfeld, and Baum (2010) establish a new form of probability and severity matrix. They decided that for the construction industry, the assessment should be setup into the three limitations. The first focuses on the probability of a loss-of-control event occurring. Secondly, the exposure of potential victims is identified based on the timing and location of the task. Lastly, the potential severity level of the accident is identified. The difference between this method and normal risk assessment matrix is that “near misses” are accounted for. Also, the risks are detailed in a time specific category based on the presence of other employees. Therefore, this type of assessment can be more effective for the construction industry because it considers all factors on the surrounding environment. According to Clemens and Pfitzer (2006), it is important to modify a risk matrix model for severity and probability based on the company and industry established levels of tolerance. The documented information can then be a useful tool in the pre-planning stages and potentially improve the overall safety of the jobsite.

The following risk assessment matrix from the Department of the Army (2006) is an essential part of a hazard analysis program with the help of three steps. The first step would be to assess the probability of the event or incident occurring. The second step would be to estimate the potential severity of the event or incident. Lastly, the risk matrix can be utilized to determine the scoring based on the corresponding severity and probability. This type of technique is not necessarily a science but can be subjective and may be more of an estimate of potential risks based on the industry or the company’s safety program. See Appendix A for definitions of terms used in Table 1.

Table 1

Risk Assessment Matrix

		Hazard Probability				
		Frequent	Likely	Occasional	Seldom	Unlikely
Severity	Catastrophic	E	E	H	H	M
	Critical	E	H	H	M	L
	Marginal	H	M	M	L	L
	Negligible	M	L	L	L	L

Note. From "Department of the Army" 2006. *Composite risk management* FM 5-19 (FM 100-14). p. 8. Washington, D.C. E = Extremely High; H = High; M = Moderate; L = Low.

Managing an AHA program

A key factor to managing an AHA program successfully is to obtain full management buy-in and support. Smith and Whittle (2001) identify that many companies struggle to establish, execute and document an effective hazard analysis program. Management should initiate and control this process in order to identify and manage the apparent hazards. Management's role should focus on analyzing and recording all potential hazards, and then evaluating how these risks can be reduced or controlled. By creating an effective process for hazard analysis, companies will be able to focus efforts on updating current AHA's rather than having to recreate them each time, thereby improving efficiency.

According to Elmendorf (1996), an assessment checklist technique can be an effective tool to examine a process. Questions should be created on the checklists to aide the user in answering with a subjective mind. The questions should be written so the user does not have to be an expert in the process, but have more of a general knowledge of the potential hazards faced during the task. According to Smith and Whittle (2001), topics for the checklists may include:

training requirements, company procedures, surrounding environment, housekeeping, personnel workload, or a number of other industry specific categories. Elmendorf states that the results of the checklist must be clearly written to be effective in identifying the potential hazards found by the user. This checklist process is simply offering a systematic approach to updating or validating a hazard analysis assessment. Elmendorf reiterates that the effectives of any hazard analysis system lies on the ability for continual improvement in managing risks.

According to Hoxie (2003), the commitment to safety comes by reviewing and studying the hazard analyses. It is important for management to effectively use the developed tools and communicate the safety plan to contractors and subcontractors in order to establish a standard for safety expectations. Using hazard analyses as a standard can guide subcontractors into demonstrating there own abilities to follow certain requirements. This exemplifies that a hazard analysis can be used by a contractor in communicating their commitment to providing the safest work environment. Subcontractors will then have the ability to offer insight on needed modifications or enhancements of the analysis. Using hazard analyses as a standard for safe operation can be an important step into overall project safety with all contractors involved.

Effectiveness of an AHA program

Swartz (2002) writes that many organizations fail to take advantage of the special benefits that effective AHA's can offer. AHA's stem from the need to develop safe procedures and standards that can serve many objectives for an organization. The process of developing a hazard analysis begins with breaking down the task into individual job steps. It is important that these steps be identified in a clear and concise manner. They should not contain an excessive amount of steps or be too general where important hazards are not adequately identified. In addition to being clear and concise, AHA's should be unambiguous, and specifically relevant to the problem. They also need to be self-contained but provide enough appropriate references for people to follow up if needed (Elmendorf, 1996).

In order to implement a successful program, it is important to understand the key objectives and limitations of hazard analysis. Swartz (2002) proposed a definition which he called the absentee method, mentioned earlier in this chapter. In this method, he refers to supervisors creating AHA's without observing the job or discussing it with frontline workers, causing poor quality of the analysis. When you compare this to his most effective method, one on one observation, it is clear that the most accurate analysis will come from a thorough study of the process. In the construction industry, the varying locations of job sites often make it difficult to observe and study a process. Therefore, accurate analysis may be suited better with a combination of observation and team discussion. In designing the AHA, effectively capturing the safety and environmental hazards in one process can help eliminate redundant work in other processes. Incorporating risk assessment into the AHA process benefits the whole corporation. Working as a team to collaborate on the activity, ensures that all parties take ownership over the process. This also produces positive benefits such as enhanced productivity and morale (Geronsin, 2001).

A high level quality AHA form can then be used by managers as an important tool, relating the process of an activity to the apparent hazards and controls. Therefore, the functional capabilities of the document lend knowledge into training new employees and offer continuous training for others (Geronsin, 2001). According to Morris (2003), the form may also be an important asset when conducting accident investigations. This must take into consideration that the AHA's are appropriately documented and stored to provide an ease of access. A company can therefore identify whether the accident was a result of substandard act or substandard condition. The use of the AHA may also lend itself in analysis of worker performance as it relates to safety. It is important that workers job tasks are represented accurately, so a business can evaluate their performance based on previous records. All of these recommendations stem from the ability of the company to accurately analyze and document all work-related activities. According to Hoxie (2003), accurate documentation of risks within a company can be very important in every function of the business. It can be used in the preconstruction and bidding phases of a project to identify the potential threats that may occur. It can also be used as a standard for safe procedures on the job. The standard can then be used to measure the effectiveness of the safety plan.

Swartz (2002) believes that the AHA document process is never truly finished because of the changing contributing factors. The completed documents should be continuously updated to reflect the most accurate information of each job. This information will be most effective if it is reviewed by multiple personnel where suggestions can be made for possible revisions. He also believes that this information can be most effective as a safety training tool for meetings and accident investigations if all relevant factors are considered. The key to being effective is to minimize the wording and the job steps in the documentation. The quality of the AHA is more important than the quantity of excessive and redundant wording that will often disguise the true objective of the AHA.

According to Aksorn and Hadikusumo (2008), the effectiveness of hazard analysis programs are often measured with a reactive approach. Collected and recordable injury data is used to evaluate how the safety program is performing. They believe that instead of being reactive, a proactive approach will be better able to identify the current level of safety based on the amount of substandard acts and substandard conditions. The conditions of the jobsite and acts of the workers are usually performed with the observation by management. The potential benefit is that they will be able to predict any potential incidents before an injury occurs. This technique is not failsafe, but it may lend quality information into evaluating trends in behavior or conditions. This approach also allows a construction company to measure the current levels of safety by evaluating whether or not they are meeting their safety objectives.

Marine Specific Hazard Considerations

The Department of the Army (2010) identifies some key factors to consider during construction activities on or around water. In relation to previous identified hazards, the Army considers marine work activities of higher risk, having the potential to cause additional harm. Therefore, it is important to assess hazards accordingly in an AHA and consider some of the following threats. There is an increased potential for electrical shock, carbon monoxide issues from motors, hypothermia, injury from impact of tools and equipment while over water and many other hazards. This makes it extremely important to continually test and monitor equipment before operation and work in a buddy system to be certain that workers are always accounted for. The safety equipment used in marine construction work is essential, making it important that the appropriate safety devices are inspected and used properly.

A study done by Walker (2000) identifies a similar focus on hazard analysis in a marine construction environment. The study incorporated a number of key additional hazardous exposures that are important to identify. There are four potential loss exposures which should be accounted for. The first focuses on the potential for casualties of surrounding waterway users. Secondly, there is a potential to disrupt other business activity in heavily trafficked waterways. The third objective focuses on the potential effects waterway users might have on the construction workers on the project. The last potential consequence is the result of a loose barge or vessel threatening other waterway users. Subcategories were established for all potential circumstances based on the location of the work on the water, the type of operations being performed, the experience level of the workers, the timing of the activity, and plans of the project.

In conducting an AHA in a marine construction environment, Walker (2000) offers some key risk-influencing factors that may need consideration. Specific to marine construction, the location of the site often lends new exposures to the hazard analysis. Factors for location include: shallow waters, flow of current, boat traffic, channel work, underwater obstructions and other site specific general concerns. Factors for time include: water levels, non-routine waterway usages, nighttime work activities, and other general concerns. If these categories are considered, management can decide on the appropriate risk factor associated with the activity. Each scenario should be analyzed individually, because one task may be acceptable in shallow waters, but not during nighttime hours. In the marine construction environment, many factors can contribute to a high, low or unacceptable level of risk for the work activity.

Conclusion

This literature review covered a basic understanding of background information relating the hazard analysis process in different industries. The key objectives for management were also identified and related to the provided study questions. The review also covered the effectiveness of the process and made recommendations for future applications. It is clear that much of the process lies on a company's ability to set standards and promote an established program. Success comes from the ability to effectively manage the assumed hazards as it relates to any industry.

Chapter III: Methodology

The research conducted was a qualitative case study comparing AHA procedures of XYZ Company with the industry's best practices for developing AHA's. Information was gathered from XYZ's current process for developing AHA's and an inventory was taken on current documentation. This chapter discusses how the research answered the following problem: In XYZ Company, the absence of a streamlined and structured process for developing Activity Hazard Analyses leads to a decrease in productivity, the potential for reduced quality hazard analysis, and could cause the AHA to be underutilized as an important safety tool. This chapter also explains the procedures used to investigate this problem and provide information about the sample, as well as provide specific details about the procedures for analysis.

Subject Selection and Description

This research involves a case study of the XYZ Company. This company was chosen because of the researchers experience with and accessibility to the management. The greater population that this research aims to study includes organizations that are currently or should be using AHA's.

Procedures for Analysis

The research study was aimed to review and document the collection of AHA's within XYZ Company. The data collected was then compared with the effective procedures as identified from the literature review for developing AHA's. This research also includes the process of how AHA's are developed, how are they documented and how they can be obtained for future projects. The study will also include an analysis of strengths and weaknesses of the current process for AHA's within the company by conducting meetings with the appropriate personnel. The following steps depict how the research was collected.

Step 1 – The researcher visited Company XYZ at their corporate headquarters to meet with the Safety Director. The Safety Director was chosen as a partner for this study because of his access to the digital copies of the AHA's. The data is housed in the company's internal computer system allowing for access from various worksites.

Step 2 – In conjunction with the Safety Director, a sample of 40 AHA's were collected and saved on a removable storage device. These documents were taken from previously implemented AHA's from at least five different worksites. Effort was taken to pick from various worksites because it offered a more representative picture of AHA's throughout different types of projects and more generalizable sample to the whole system.

Step 3 – An informal meeting was established with four available personnel having direct experience with the AHA process to discuss the company's current AHA program. Each attendee was given the implied consent form (Appendix B) before the meeting was started. Topics were based according to Appendix C, with the intention to provide a strong understanding for the complete AHA system and uses. Thorough notes were taken during the discussion for later analysis.

Step 4 – A set of guidelines and checklists (Appendix D) were created from the reviewed literature to evaluate the AHA's. The information and data from the sample of 40 were evaluated on the basis for comparison to current industry best practices as defined in review of the literature. This information gained from the checklist was used to identify deficiencies in the current process.

Step 5 – The meeting notes were analyzed for significant comparison and contrasts of opinion on the AHA program. A number of points were collected to identify efficiencies and deficiencies in the current process.

Step 6 – Based on the evaluation of the current AHA system, the researcher developed a set of recommendations to improve the AHA process. Sample forms are provided that will potentially aide the AHA process with new recommendations to Company XYZ for their future use, testing and evaluation.

Limitations

A limitation of this study was that the results are based on information from one company and may not be generalized to the larger population.

Summary

This chapter included a full explanation of this study's procedures based on company XYZ. This study was designed to answer the problem statement discussed earlier in this chapter. The analysis procedures were designed to identify and relate the key deficiencies in the AHA process. Chapter four will go on to explain the results of the study, give information about the specific findings, and make recommendations for future changes.

Chapter IV: Results

The purpose of this paper was to define an adequate and efficient AHA process to be used in the marine construction industry. This AHA process can be used as a tool for future safety managers and will be centered on assessing and reducing risk for marine construction activities. Information was gathered from XYZ's current AHA program through a meeting format and a sample of 40 AHA's were taken for later assessment. Chapter four includes the procedures used to evaluate each AHA that was collected, a discussion of the results found, as well as the results of the meeting held with the managers to gain additional insights on the AHA process. This chapter also relates these findings back to the literature review and highlights important points for further discussion in Chapter five.

AHA Data Collected

A random sample of 40 AHA's were collected from Company XYZ's internal computer system. As stated earlier in the research, AHA's are a requirement for all Army Corps job and can sometimes be required by other customers. It was determined in Appendix E that 22 of the sample 40 were Army Corps of Engineers specific jobsites. This finding recognizes that Company XYZ is not just meeting a requirement, but using the AHA to support other work activities. The AHA's collected represent all divisions of work activity in order to provide the best overall summary. The samples were evaluated based on the checklist designed by the researcher in Appendix D and the results can be found in Appendix E. The evaluation of this sample revealed a number of important points which will be discussed. Table 2 represents a summary of the guidelines data gathered from Appendix E as follows:

Table 2

Guidelines for the AHA Results

	Sample amount	AHA's which met guideline	Percentage needing improvement*
Identify all steps	40	35	12.5%
Identify potential hazards	40	26	35%
Sufficient controls	40	29	27.5%
Clear and concise	40	30	25%
Accessible	40	40	0%

* Percentage needing improvement is based on the researcher's guidelines for AHA's.

The first key point taken from the data in Table 2 involves a small percentage (12.5%) of the sample that did not provide adequate job steps. Five out of the sample 40 AHA's contained inadequate job steps and did not necessarily follow the correct sequence. According to Swartz (2002) AHA's stem from the need to develop safe procedures and standards for operation by breaking down the tasks into individual job steps. They should not contain an excessive amount of steps or be too general where important hazards are not adequately identified. The AHA's identified in the sample neglected certain hazards because of the lack of clarity in the sequence of steps. Adequately defining all steps is essential in order to identify the potential hazards and needed controls. From an outside perspective, the readability of sequential job steps is unclear and not concise among the 12.5% in these recorded AHA's. Job step sequence is important in order to determine that all precautions are taken and that integral parts of the process are not overlooked.

Table 3 offers a more descriptive approach to the AHA study with the use of the checklist in Appendix D and the data in Appendix E to summarize the data. The information and statistics were used to identify key issues in relation with Table 2.

Table 3

AHA Checklist Results

	Sample amount	AHA's which met checklist	Percentage needing improvement*
Work activity	40	40	0%
Preparer	40	40	0%
Completion date	40	40	0%
More than 2 years old	40	0	0%
More than 1 AHA	40	0	0%
Comparable	40	n/a	n/a
Need for revalidation	40	0	0%
Centrally located	40	40	0%
Missed hazards	40	14	35%
Tools and equipment considered	40	20	50%
Project name	40	40	0%
Documentation	40	40	0%
Section for tools and equipment	40	36	10%
Job tasks need to be clearer	40	13	32.5%

* Percentage needing improvement is based on the researcher's criteria outlined in the checklist items.

An important finding that can be taken from Table 3 is that 50% of the AHA's did not include the necessary equipment, inspections or training needed for the activity. In the entire sample, this section was available 90% of the time but only completed half of the time. In the Safety and Health Requirements manual issued by the U.S. Army Corps of Engineers (USACE) (2008), the content and objectives of the analyses are stated as an opportunity to identify new job tasks, their potential hazards and the controls used to minimize loss. Consideration of inspection requirements, training and equipment is a requirement for every AHA document submitted to the Corps. It may be that the section is more often completed on site in order to ensure the proper items are identified. This step may be beneficial even when not a requirement in order to identify the need for specifically trained personnel, inspection techniques and procedures or new engineering and administrative controls.

Another important point that can be taken from Table 2 and Table 3 is that 35% of the sample AHA's did not identify all potential hazards or conditions. Consideration of this point is based on the researcher's general observation of the AHA's in comparison with other AHA's. Also, the checklist found in Appendix G was used to evaluate each activity to develop a general understanding of potential hazards or conditions. In a number of cases, varying hazards were grouped as one, which limited the amount of controls that should be considered. As found in Table 2, 27.5% of the sample AHA's did not specify sufficient controls. This observation is based on the researcher's perspective in comparison to other fully developed AHA's and with reference with Appendix G. It is important to consider all categories of hazards when planning the analysis process. Morris (2003) identifies chemical, biological, physical, psychosocial and mechanical as the main categories of hazards that should be recognized in order to effectively control exposures. Understanding these hazard categories are just the basic requirements to identify loss exposures. Also, some hazards were recorded in one activity and not in another similar activity. The information clearly shows a need for additional control measures that were not initially identified. It may be a more prudent approach to caution on the side of more hazard considerations rather than the minimum. If one or multiple hazards are not applicable, it would be easier to remove these rather than rethink and prepare a new AHA.

In comparison of the Tables, a clear deficiency can be attributed to the fact that 25% (see Table 2) of AHA's need to be more concise and clear, while 32.5% (see Table 3) need to have the job steps better defined. This is based on the researcher's assessment of readability of the AHA and order or sequence of the job tasks. These previous factors could lead to an employee being unaware of potential job hazards or conditions.

Along with the previous deficiencies in the collected AHA's, a number of strong points were identified. It can be concluded from Table 2 and Table 3 that all employees have access to the AHA's through the corporate internal software. This is an important advantage because it allows for continual improvements and awareness of the hazard analysis program. According to the Department of the Army (2010), the use of an AHA is an important component to the overall safety management program. Allowing accessibility for personnel will ensure work activities are conducted at the lowest possible level of risk while protecting workers and the surrounding communities.

Another factor for support is that based on Appendix E, the AHA program has recently been updated and Table 3 shows that no AHA's older than two years were found. Therefore, no revalidation was needed at this time. As covered in the literature review, Smith and Whittle (2001) outlined the important steps to update and revalidate AHA's. Since data shows that all AHA's are current, it can be concluded that Company XYZ is using their resources to practice this technique and effectively updating hazard analyses. This technique will lead to a decrease in their potential future losses. Looking back on the literature, Swartz (2002) believes that the AHA document is never truly complete because of the continuously changing environment. The completed documents can be most beneficial when they are regularly updated to reflect the most accurate information of each job.

Another important strong point found among this sample in Table 3, was that all relevant information was provided in order to assure proper documentation and record keeping. The overall perspective from this data is that the AHA's were relatively clear and concise. Of the sample of 40, 10 AHA's would benefit from clarification on the overall perspective of the activity. This could be attributed to the fact that the AHA process is currently being implemented in new divisions and will take some time to have all employees follow the program efficiently. Swartz (2002) explains that the quality of information contained in the AHA is most often the key to effectiveness. The important issues in the data show that Company XYZ is taking the initiative to effectively manage risk with the help of an efficient AHA program.

Meeting Summary

In the meeting with supervisors, four key points were identified. These points will draw conclusions as to the current AHA process and potential areas for evaluation. The questions were presented based on Appendix C to the available personnel and the results can be found in Appendix F. Information obtained in the meeting draws clear evidence of strong support for continual development and implementation of AHA's from management. Written policies have been established within the company that are designed to effectively manage apparent risks. The purpose of the program is to control risks by identifying hazards, reducing exposures, providing awareness and continually updating AHA documents. According to Swartz (2002), there are four key objectives to obtaining a quality and successful AHA process. The objectives can be accomplished as follows: gain management support, train supervisors and employees on providing accurate information regarding tasks, a written program and to assign personnel to direct the objectives of the program. It can be concluded from the results of meeting presented in Appendix F that Company XYZ has taken the responsibility to address all of these objectives.

Another key component obtained through the meeting was the current uses of the AHA. It can be determined from the question presented in the meeting (Appendix F) that it is mostly used as a requirement for certain jobs and as a training tool on job sites, but it is not integrated into all divisions just yet. From the information gathered in Appendix E, it is evident that AHA's are available on all jobsites, but sometimes used in different capacities based on the requirements. There are still areas in the company that are not familiar or affected by AHA's. For instance, Company XYZ has just begun to integrate this program into the marine transportation division, which is not a requirement. This principle as defined in chapter two identifies the initiative that XYZ is taking to integrate this document into all facets of the business in order reduce overall exposures. According to Hoxie (2003), accurate documentation of risks within a company can be very important in every function of the business. It can be used as a tool for many different phases of a project in order to identify potential hazardous exposures. Also, it can provide a standard for safe procedures on the job that can be used to measure the effectiveness of the overall safety plan.

As acknowledged in chapter two, it is important to assign a leader for the program. It was determined in the meeting and found in Appendix F, that the AHA process is managed and overseen by the Health and Safety Department. However, it is mostly utilized through a line management system. Safety department personnel are not available on every site; therefore

AHA's are often modified at each worksite and approved by the available safety or management personnel. As suggested in the literature review, a successful strategy for AHA's is to establish a developed supply that are available for use by any site personnel and can be modified as needed based on requirements and approvals. There are many tools that the Department of the Army (2010) suggests can be used in a safety program. As stated earlier, the Army acknowledges that the simple AHA document is not a sufficient safety plan. But, the use of this document for regular health and safety inspections can identify whether the safety standards are being accomplished. In the line management system, corrective action plans can help determine long-term and short-term goals that will effectively track changes in processes or equipment while eliminating, controlling or reducing hazardous exposures at each jobsite. The leader of the program will use current information to establish a set of guidelines for inspection and continual monitoring of the health and safety program.

To achieve the greatest result for developing quality AHA's, everyone in the meeting agreed that the group method is most often preferred. However, due to certain circumstances; the technique of recalling steps is occasionally used during the some stages of work. As reviewed in the earlier literature, Swartz (2002) suggests the following techniques to prepare an AHA: one on one observation, group discussion, recall the steps and the absentee method. Company XYZ prefers the group technique to obtain the most accurate analysis from a collection of individuals that will examine a process and discuss the key hazardous exposures to each step. Since Company XYZ is using both the group discussion and recall technique, it can be determined that they are acknowledging the effectiveness of each technique in order to apply the right method to the situation.

Summary

This chapter summarized the results taken from the sample of 40 AHA's and from the meeting of personnel. Data was taken from the research and compared with many of the best practices found in the literature review. The following chapter will provide a more in depth discussion of the meaning of these results. It will also provide recommendations for improvement to the AHA process and for areas of further research.

Chapter V: Conclusions and Recommendations

The purpose of this paper was to define an adequate and efficient AHA process to be used in the marine construction industry. This AHA process can be used as a tool for future safety managers and will be centered on assessing and reducing risk for marine construction activities. Information was gathered from Company XYZ's current AHA program through a meeting format and a sample of 40 AHA's were taken for later assessment. Chapter four included the procedures used to evaluate each AHA collected, a summary and discussion of the results found, as well as the discussion of results obtained in the meeting. This chapter will define the major conclusions found in the study and offer some recommendations into possible areas for improvement.

Conclusions

Based on the data collected in the sample AHA's and from the meeting, the following conclusions can be made about efficiencies in the AHA process for Company XYZ:

- An efficient aspect of the process taken from the data in Table 2 and Table 3 is that Company XYZ provides accessibility for all employees to the collection of AHA's through the corporate internal database. The accessibility allows all employees the ability to reference the steps and hazards of a work activity at any time.
- It can also be concluded that the current AHA program was recently updated based on the meeting (Appendix F), and Table 3 shows that no AHA's older than two years were found. Therefore, no revalidation was needed at this time. This shows efficiency in the process where current relevant work activities are documented and up to date.
- The data in Table 3 shows that Company XYZ has provided the appropriate information in order to assure documentation and record keeping is consistent. This is important to

ensure all employees are trained on their assigned work activities. Also, in the case of an accident, this documentation can lend information into possible substandard acts or conditions that led to the accident.

- Information obtained in the meeting draws clear evidence of strong support for continual development and implementation of AHA's from management.
- It was determined in the meeting as indicated in Appendix F, that the AHA process is managed and overseen by the Health and Safety Department, which means that a clear leader of the program has been established.
- To achieve the greatest result for developing quality AHA's, each participant in the meeting agreed that the group method is most often preferred. However, due to certain circumstances; the technique of recalling steps is occasionally used during the some stages of work.
- It was determined from the data in Appendix E that 22 of the sample 40 were Army Corps of Engineers specific jobsites. This finding recognizes that Company XYZ is not just meeting a requirement, but using the AHA to support other work activities.

Based on the data collected in the sample AHA's and from the meeting, a number of potential deficiencies were identified as follows:

- The analysis of the sample AHA's showed that 12.5% of the sample did not provide adequate job steps. Five out of the sample 40 AHA's contained inadequate job steps and did not necessarily follow the correct sequence. These documents will therefore not be very effective in the training process or by identifying all potential hazards.
- The sample data also showed that 25% (see Table 2) of AHA's need to be more concise and clear, while 32.5% (see Table 3) need to have the job steps better defined. This was

based on the researcher's assessment of readability of the AHA. The AHA's were assessed based on how an outside audience would interpret the activity if they would have little experience in that area. This stems from the point that the use of AHA's as a training tool should show sufficient information in order to train new employees.

- The review of the data and summary taken from Table 2 and Table 3 is that 35% of the sample AHA's did not identify all potential hazards or conditions. Consideration of this point is based on the researcher's general observation of the AHA's in comparison with relative information found in other sample AHA's. Also, the checklist found in Appendix G was used to evaluate each activity to develop a general understanding of potential hazards or conditions. In a number of cases, varying hazards were grouped as one, which limited the amount of controls established. This correlates to how 27.5% of the sample AHA's did not specify sufficient controls for the hazards identified.
- The summary of data from Table 3 shows that 50% of the AHA's did not include the necessary equipment, inspections or training needed for the activity. In the entire sample, this section was available 90% of the time but only completed half of the time. This may not be a strong area of concern because this section would most often be updated at each site. However, it may be important to include this information on the original document in the computer system in order to adequately consider all possible concerns.

Recommendations

Based on the data that was gathered and the conclusions stated, the following administrative control measures are made as a recommendation based on the deficiencies found for Company XYZ. These measures are intended to act in support for reducing overall exposure to risk through utilization of AHA's with a structured and efficient process:

- Integration of a hazard consideration checklist during the development and revalidation process may be considered as a useful tool in order to efficiently identify all possible exposures. OSHA (2002) offers a basic list of the many potential hazards that may need to be identified which can be found in Appendix H. However, this list is not an all inclusive list and there may need to be other considerations that are more specific to the marine construction industry.
- A strong recommendation would be to consider establishing a written training policy that will act as the standard for measurement of success for the program. The results of compliance with the standard may lend information into determining whether corrective actions are needed. This will help with continually updating and revalidating the documents, as well as involving the employees with the process so that all hazards can be addressed. Training employees on the aspects of AHA's may provide more sufficient content when it comes to job steps, eliminating the potential for missed hazards.
- The implementation of a risk matrix for each AHA or activity as identified in the literature review and found in Appendix A may be a beneficial tool in documenting work activity risks. The potential benefit is that the frequency and severity of the tasks will be categorized, helping prepare employees for an understanding of the potentially hazardous outcome of the work activity.
- The implementation of a process for verifying the accuracy of the AHA's could include occasionally observing employees performing activities identified in the AHA by following the document closely. This review process policy has the potential to identify potential areas of concern from a substandard act or condition perspective before an

accident was to occur. Therefore, actions can be taken to improve or address the issue with a proactive approach.

Areas of Further Research

The scope of this study focused only on one issue within Company XYZ. This study can be related into other marine construction contractors or other industries that implement AHA's. The following areas may be considered for further research based on hazard analysis as a whole:

- Replicate this study in a variety of different industries in order to determine trends in efficient AHA's.
- The field of research for hazard analysis in marine construction in general needs more exploration for definitive AHA management techniques.
- Compare loss histories with AHA documents to determine if there is any correlation between the incident and a breakdown in the recommended hazards and controls.

References

Aksorn, T., & Hadikusumo, B.H.W. (2008). Measuring the effectiveness of safety programmes in the Thai construction industry. *Construction Management and Economics*, *26*, 409-421.

Bancroft, K. (2002). Job hazard analysis for unsafe acts. *Occupational Health & Safety, 71*(9), 206-215.

Clemens, P., & Pfitzer, T. (2006, January). Risk assessment & control. *Professional Safety, 51*(1), 41-44.

Department of the Army. (2010). *Army safety program* (pamphlet 385-10). Washington, D.C.

Department of the Army. (2006). *Composite risk management* FM 5-19 (FM 100-14). Washington, D.C.

Elmendorf, M. (1996). Introduction to process hazard analysis. *Journal of Environmental Law & Practice*, *4*(1), 36-56.

Geronsin, R. (2001). Job hazard assessment: A comprehensive approach. *Professional Safety*, *46*(12), 23-30.

Hoxie, W. (2003, October). Preconstruction risk assessments. *Professional Safety, 48*(10), 50-53.

Morris, J.A., & Wachs, J.E. (Eds.). (2003). Implementing a job hazard analysis program. *AAOHN Journal*, *51*(4), 187-193.

Occupational Safety and Health Administration. (2002). *Job hazard analysis* (OSHA 3071).

Palmer, J.P. (2004). Evaluating and assessing process hazard analyses. *Journal of Hazardous Materials, 115*, 181-192.

Rozenfeld, O., Sacks, R., Rosenfeld, Y., & Baum, H. (2010). Construction job safety analysis. *Safety Science*, *48*, 491-498.

Smith, K.E., & Whittle, D.K. (2001). Six steps to effectively update and revalidate PHAs. *Chemical Engineering Progress*, *97*(1), 70-77.

Swartz, G. (2002). Job hazard analysis. *Professional Safety*, *47*(11), 27-33.

U.S. Army Corps of Engineers. (2008). *Safety and health requirements manual* (EM 385-1-1). Washington, D.C.U.S. Government Printing Office.

Walker, D.A. (2000). *Field demonstration workshop on managing risks associated with marine construction activities.* Unpublished manuscript.

Appendix A: Army Risk Matrix Definitions

		Hazard Probability				
		Frequent	Likely	Occasional	Seldom	Unlikely
Severity	Catastrophic	E	E	H	H	M
	Critical	E	H	H	M	L
	Marginal	H	M	M	L	L
	Negligible	M	L	L	L	L

Note. From "Department of the Army" 2006. *Composite risk management* FM 5-19 (FM 100-14). p. 8. Washington, D.C. E = Extremely High; H = High; M = Moderate; L = Low.

Frequent – Occurs very often, known to happen regularly
Likely – Occurs several times, a common occurrence
Occasional – Occurs sporadically, but is not uncommon
Seldom – Remotely possible, could occur at some time
Unlikely – Probably will not occur, but not impossible

Catastrophic
Complete shutdown of project
- Death or permanent total disability
- Loss of major equipment
- Major property or facility damage
- Severe environmental damage

Critical
Severe downgrade to project status
- Permanent partial disability or temporary total disability
- Extensive major damage to equipment or systems
- Significant damage to property or the environment

Marginal
Downgrade of project goals
- Minor damage to equipment or systems, property, or the environment
- Lost days due to injury or illness
- Minor damage to property or the environment

Negligible
- Little or no adverse impact on project
- First aid or minor medical treatment
- Slight equipment or system damage, but fully functional or serviceable
- Little or no property or environmental damage

Appendix B: Implied Consent Form

UW – Stout Implied Consent Statement for Research Involving Human Subjects

Consent to Participate In UW-Stout Approved Research

Title: Activity Hazard Analysis in a Marine Construction Environment

Investigator:
Ryan Olsen
N6370 912th St.
Elk Mound, WI 54739
Phone: 262-325-5529

Research Sponsor:
Dr. Bryan Beamer
Email: beamerb@uwstout.edu

Description:
The objective of this research will be to define an adequate and efficient process for developing AHA's in a marine construction environment. The information collected from this meeting and a sample of previously implemented AHA's will be used to identify deficiencies in the current process and eventually lead to a new streamlined process that will be effective in assessing and reducing risk in the industry.

Risks and Benefits:
There are no known risks for participating in this study. The potential benefits will be to provide an effective procedure for identifying and controlling risks associated with marine construction, while also having a positive impact on overall safety.

Time Commitment:
The expected time commitment for this meeting will be approximately one hour.

Confidentiality:
Your name will not be included on any documents. We do not believe that you can be identified from any of this information.

Right to Withdraw:
Your participation in this study is entirely voluntary. You may choose not to participate without any adverse consequences to you. However, should you choose to participate and later wish to withdraw from the study, there is no way to identify your anonymous document after it has been turned into the investigator.

IRB Approval:

This study has been reviewed and approved by The University of Wisconsin-Stout's Institutional Review Board (IRB). The IRB has determined that this study meets the ethical obligations required by federal law and University policies. If you have questions or concerns regarding this study please contact the Investigator or Advisor. If you have any questions, concerns, or reports regarding your rights as a research subject, please contact the IRB Administrator.

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Statement of Consent:
By taking part in this meeting you agree to participate in the project entitled, Activity Hazard Analysis in a Marine Construction Environment.

Appendix C: Meeting Questions

Questions to be answered

Is there management support?

Are supervisors and employees trained on using AHA's?

Is there a written program?

Is there a director of the program?

Who has access to the developed AHA's?

How is the completed AHA used?

What techniques are used to develop?

- ☐ One on One observation
- ☐ Group
- ☐ Recall Steps
- ☐ Absentee method

Appendix D: AHA Guidelines and Checklist

Guidelines for AHA

The below guidelines were used to evaluate each documented AHA.

- Does it identify all possible steps?
- Are all potential hazards identified?
- Are the controls sufficient for the identified hazards?
- Is it clear and concise?
- Are they accessible to all employees?

Checklist

This checklist was used to analyze the AHA's and record deficiencies in the AHA process.

- ☐ Work activity is stated
- ☐ Preparer of AHA is stated
- ☐ Date of completion is stated
- ☐ Is the AHA more than 2 years old?
- ☐ Is there more than 1 AHA for same task?
- ☐ If more than one same AHA, are they comparable?
- ☐ Does the AHA need to be revalidated?
- ☐ Are they centrally located for access?
- ☐ Are potential hazards missed?
- ☐ Are Tools and Equipment identified?
- ☐ Project named identified
- ☐ Documentation Sign in sheet is attached
- ☐ Army Corps specific activity
- ☐ Is there a section for tools and equipment?
- ☐ Do the job steps need to be clarified?

Appendix E: AHA Data Collection

Sample Number (1-20)	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20
Guidelines for AHA																				
Does it identify all possible steps?	x	x	x	x	x	x	x	x	x	x			x	x	x	x	x	x	x	x
Are all potential hazards identified?	x				x	x	x	x	x	x				x	x	x	x	x		x
Are the controls sufficient for the identified hazards?	x				x	x	x	x	x	x			x	x	x	x	x	x		x
Is it clear and concise?					x	x	x	x	x	x			x	x	x	x	x	x	x	x
Are they accessible to all employees?	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x
CHECKLIST																				
Work activity is stated	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x
Preparer of AHA is stated	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x
Date of completion is stated	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x
Is the AHA more than 2 years old?																				
Is there more than 1 AHA for same task?																				
If more than one same AHA, are they comparable?																				
Does the AHA need to be revalidated?																				
Are they centrally located for access?	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x
Are potential hazards missed?		x	x	x							x	x	x						x	
Are Tools and Equipment identified?							x		x	x				x		x	x		x	x
Project named identified	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x
Documentation Sign in sheet is attached	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x
Army Corps specific activity							x	x	x	x	x	x	x	x	x			x		
Is there a section for tools and equipment?					x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x
Do the job steps need to be clarified?	x	x	x	x							x	x					x			

Sample Number (21-40)	21	22	23	24	25	26	27	28	29	30	31	32	33	34	35	36	37	38	39	40
Guidelines for AHA																				
Does it identify all possible steps?	x	x	x	x	x	x	x	x	x	x	x			x	x	x		x	x	x
Are all potential hazards identified?		x	x	x		x		x	x	x	x		x	x	x	x				x
Are the controls sufficient for the identified hazards?	x	x	x	x		x		x	x	x	x		x	x	x	x		x		x
Is it clear and concise?	x	x	x	x	x	x		x	x	x	x	x		x	x	x			x	x
Are they accessible to all employees?	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x
CHECKLIST																				
Work activity is stated	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x
Preparer of AHA is stated	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x
Date of completion is stated	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x
Is the AHA more than 2 years old?																				
Is there more than 1 AHA for same task?																				
If more than one same AHA, are they comparable?																				
Does the AHA need to be revalidated?																				
Are they centrally located for access?	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x
Are potential hazards missed?	x				x		x					x	x				x	x	x	
Are Tools and Equipment identified?	x	x						x	x		x	x	x			x	x	x	x	x
Project named identified	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x
Documentation Sign in sheet is attached	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x
Army Corps specific activity			x	x	x	x	x		x	x	x	x	x	x	x					
Is there a section for tools and equipment?	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x
Do the job steps need to be clarified?							x					x	x				x	x	x	

Appendix F: Meeting with Company XYZ
March 14, 2011
Researcher: Ryan Olsen

Number of Attendees: 4

Questions and answers:

Is there management support?

- There is management support, but as far as managing the process they try to lead by example, so they don't just use them, they try to follow what is written in the AHA. Also, there is management support with the documentation and the training.

- There is management support through developing the AHA's at the beginning stages that are a requirement for the accident prevention plan through the corps jobs. Therefore management supports the continual use and development of AHA's.

- There is management support. The best way to get that is to review the documentation with the superintendant of the project in order to make sure the tasks have been identified.

- Absolutely management support. Commitment to using them as a safety and leadership tool. They have even begun to implement then in the fleet marine department.

All agreed there is management support of the AHA program.

Are supervisors and employees trained on using AHA's?

- Supervisors and managers are trained on AHA's and they recently just had a manager's conference to go through some training relating to AHA's. All regular employees are not necessarily trained, so the crews aren't always utilizing AHA's. This may affect how they are updated.

- According to their Accident Prevention Plan, for the corps jobs, everyone must have access to the AHA's. Therefore, before each activity, AHA's are used during the prep meeting of about 6 personnel with the core of engineers to review the daily activities.

- When the employees and supervisors are trained, they go through the AHA as a part of the pre-submittal stage.

- Supervisors and employees are trained where needed, pre-shift and pre-task. And they are encouraged to ask questions and incorporate a new change in task if needed. Sometimes they have to make a midstream change in the task when a new procedure or hazard arises, final working copies are saved for future reference.

Is there a written program?

- Yes, there is. There is a written policy in place that identifies what needs to be considered with an AHA.
- Yes, and it is available for anyone online.

Is there a director of the program?

- Corporate initiates the program and supervisors, site managers, safety representative or project managers implement it.
- Director is the safety department. On the site, it is the project manager or safety specialist on that site that will lead the program or initiative.
- The safety department develops the AHA's that are often tweaked at each site to reflect the job. They are used during the prep meeting and some of the daily safety topics. If they have to make changes to the AHA they do not have to resubmit to the corps of engineers, necessarily, so they are free to make changes on site as needed.
- A multi-tiered management structure, basically managed by the health and safety department at any job, but needs management approval and it has to meet the requirements. Anyone can develop one but it still has to get the approval by safety department.

Who has access to the developed AHA's?

- Superintendent does the revisions based on the task, hazards are updated by the safety department and they use historical data or working copies to continually improve and provide to employees via the corporate internal computer program.
- Everyone else answered this question the same

How is the completed AHA used?

- All tasks are written first, and then potential hazards are identified, then controls for the hazards identified. Often times copy and paste will be used from previous AHA's hazards and controls. From one perspective, there has not been much use in the field (not been a part of corps jobs yet) as a safety topic but thinks it may be beneficial in the future. The AHA as potential to be more utilized as a resource.
- AHA's are taken from past or previous work and add specifics from each job. They use AHA's in the site orientation for employees. Managed by safety or project manager for

each site. Also they like to incorporate them into weekly safety meetings. Not every hazard is presented to the crew from the AHA's in meetings because they might not be relevant to the day or not as severe a hazard. It is important to have more regular reviewing of AHA's to stay current on processes and add more input from supervisors.

- Besides all the regulatory requirements, he uses them as safety meeting topics. They can be most beneficial as well when continual improvements and updating are made.

- The AHA is used on every site. Often used in the pre-bidding process as a guess of what the hazards might be for the projects they are bidding on. And it is used most often by the project managers, superintendants and site safety departments. Since there is currently a new AHA program in place, everything is in the testing stage to see how things will function and evaluation will be done as needed.

<u>What techniques are used to develop?</u>

- ☐ One on One observation
- ☐ Group
- ☐ Recall Steps
- ☐ Absentee method

The ideal technique is through group discussion which they prefer most. But, sometimes they may need to just recall the steps depending on the situation and what stage of the project they are currently at. In the pre-bidding stage, the recall of steps is most often used.

Appendix G: Hazard Considerations

Basic considerations for potential Hazards

- ☐ Struck by
- ☐ Struck against
- ☐ Caught between
- ☐ Contact with
- ☐ Contacted by
- ☐ Caught in
- ☐ Caught on
- ☐ Fall from same level
- ☐ Fall to below
- ☐ Overexertion
- ☐ Exposure

Categories of Hazards that should also be considered and identified

- ☐ Chemical - (effects on a person's health, the flammability potential and reactive capabilities).
- ☐ Biological – (exposure to viruses, fungi, mold or bacteria).
- ☐ Physical – (temperature extremes, noise, electrical energy, or vibrations).
- ☐ Psychosocial – (exposure to nature, organizational culture, management style, content of the job task).
- ☐ Mechanical – (may be put stress on the body)

Appendix H: Hazards and Controls Reference Checklist
OSHA Job Hazard Analysis (2002)

Controls used to eliminate or reduce risks.

Engineering – Eliminate, Enclose, Isolate, or Removal or redirection.
Administrative – Written procedures, Exposure time limitations, monitor use of hazardous material, warning devices, and training.
PPE – Should only be acceptable when other controls are not feasible under the circumstances.

Hazards and descriptions

Chemical	Toxic – affects on human health Flammability potential Corrosive – damages or changes materials
Explosive	Chemical reaction Over-pressurization – sudden release of pressure
Electrical	Shock/short circuit – contact with or exposure to power source Fire – potential for overheating, or ignition of flammable Loss of power – safety critical equipment failure
Ergonomics	Strain – overexertion or repetition on body Human error – design, procedure or equipment is error-provocative
Excavation	Collapse – improper shoring
Fall	Slip, trip, or fall
Fire/heat	Cause burns to skin or damage to organs
Mechanical Vibration	Chaffing/fatigue – damage to nerve endings, or material fatigue
Mechanical failure	Device or equipment exceeds capacity
Mechanical	Skin, muscle, or body part exposed to crushing/caught-between
Noise	levels above 85 dBA 8 hr TWA
Radiation	Ionizing – X-rays, alpha, beta and gamma Non-ionizing – UV, infrared, microwaves, and visible light
Struck by	Mass acceleration – falling or moving objects
Struck against	Coming into contact of a surface
Temperature Extreme	Heat/Cold – heat stress, exhaustion, hypothermia
Visibility	Lack of lighting or obstructed vision
Weather phenomena	Snow/Rain/Wind/Ice
Other	Site specific hazard considerations