

# SAFETY IN THE MARITIME CONSTRUCTION SITE: CAPTURING LESSONS LEARNED

Jose Rocha<sup>1</sup> and Anoop Sattineni<sup>2</sup>

## ABSTRACT

*The aim of this research is to examine the safety culture of the United States Army Corps of Engineers staff and contractors working on marine construction projects including dredging, beach nourishment, breakwaters, and jetties. A literature review was performed to understand existing issues and to develop a research methodology for the study. Qualitative data research was used to uncover significant themes and help gain a deeper understanding of safety related issues. Twelve construction professions were interviewed using semi-structured interview format. The data was analysed using thematic analysis techniques with an inductive approach to draw conclusions. The results were used to conclude that issues causing safety accidents in the maritime construction sector can be broadly attributed to unforeseen conditions, training, complacency, lack of support of safety and crew unpreparedness. Data from the interviews also indicates ways to improve maritime construction can be broadly categorised under training, improved communication, improved preparation and organisational support for safety.*

**Keywords:** Maritime Construction; Safety Culture; Semi-Structured Interviews.

## 1. INTRODUCTION

This research is a look at the safety culture of the contractors and the United States Army Corps of Engineers (USACE) personnel performing and overseeing construction on various maritime projects for the USACE. Emphasis is on marine construction, including dredging, beach nourishment, and jetty and breakwater construction projects. Finding accident statistics for maritime construction projects has proved a difficult task. However, the Health and Safety Executive (HSE) does categorise between general construction and offshore construction projects. The general construction sectors cover all construction operation on land while the offshore covers offshore installations only. According to the HSE, there is a higher chance of an injury from being struck by a moving or falling object during offshore construction (Cruickshank and Cork, 2005). The aim of this research is to identify causes of maritime construction related safety accidents and make recommendations to minimize them.

The International Maritime Organization (IMO) stresses safety culture on vessels as a top priority, in shipping companies and in the shipping industry as such. The IMO states that “An organization with a ‘safety culture’ is one that gives priority to safety and realizes

---

<sup>1</sup> Student, School of Building Science, Auburn University, USA, [jzr0084@auburn.edu](mailto:jzr0084@auburn.edu)

<sup>2</sup> Associate Professor, School of Building Science, Auburn University, USA, [sattian@auburn.edu](mailto:sattian@auburn.edu)

that safety has to be managed like other areas of the business” (Ek, et al., 2014). A safety culture ensures that employees can perform their job comfortably knowing that they will be able to go to work and come home safe at the end of the day. A safety culture helps drive a proper response when an accident or emergency does occur (Experts, 2022). Maritime work is particularly hazardous due to the hostile environment and uncertainty caused by the combination of weather, waves, currents, and tides. At present, there is little health and safety related guidance available to assist coastal/maritime contractors and to ensure this work is undertaken in a safe manner (Cruickshank and Cork, 2005). Understanding the most common violations can help prevent accidents and improve compliance in laws and regulations. Understanding the top injury occurrences in marine construction helps prevent injuries, keeps the workforce safe and reduces workers compensation costs. Literature suggests that common injuries during marine construction include overexertion, slips, trips, and falls, contact with objects or equipment, transportation incidents, exposure to harmful substances or environments, workplace violence and repetitive motion related injuries (Hofmann, n.d.).

USACE is the federal agency in the United States that maintains almost all of the nation’s infrastructure, as it relates to waterways. The agency also oversees all federally funded maritime construction projects. This research is a review of the USACE construction personnel and contractors’ safety culture during heavy civil construction projects. It will evaluate the safety mentality and establish reasons for recent issues and discuss possible solutions for improvement. The goal is to gather information that may be utilized to improve safety during construction of the various projects, utilizing semi-structured interviews gathered from USACE experts in safety and construction as well as from USACE contractors involved in marine construction.

## **2. LITERATURE REVIEW**

### **2.1 GAPS IN ACCIDENT DATA IN MARITIME CONSTRUCTION**

The construction industry has had many advances in construction safety equipment, technology, and training, despite these advancements it continues to face high rates of fatal and non-fatal injuries and accidents among its workers (Mehata, et al., 2019). Determining the most dangerous industry depends on the measure used to compare danger. The Bureau of Labor Statistics (BLS) produces data through the ‘Injuries, Illnesses, and Fatalities’ (IIF) program. This program produces a wide range of information about workplace injuries and illnesses and are reported annually through the Survey of Occupational Injuries and Illnesses (SOII) and the Census of Fatal Occupational Injuries (CFOI). The IIF program presents data for the industry on the number of workplace fatalities and the rates of workplace injuries and illnesses per 100 full-time workers in heavy and civil engineering construction. However, it is difficult isolate maritime construction related safety incidents from the data presented, as evidenced by the data shown in Table 1. The data only describes ‘Other heavy and civil engineering construction’ as a category and is not further broken down to show incidents related to ‘Marine Construction’. This represents a significant gap in the recording of accidents in maritime accidents. Additionally, a literature search on the topic produced significantly less results as compared to safety issues for construction on land. The authors posit that inadequate data and research is a clear justification for conducting this research.

## 2.2 SAFETY IN USACE

Developing a strong safety program can help prevent workplace injuries, improve compliance of regulations, and reduce costs of insurance and reductions in workers' compensation premiums. Over the past four decades the rate of worker deaths and reported injuries has decreased by more than 60%. However, every working day nearly 5 construction workers are killed in the United States (Marefat et al., 2018). Prior to the start of construction, the USACE requires an Accident Prevention Plan (APP) approved by the USACE construction management and safety team. The APP includes contents such as a statement of safety, training, safety and health inspections, accident reporting, various plans (e.g., Emergency response, health hazard communication, traffic control, fire prevention) and Site Safety and Health Officer (SSHO) qualifications. The contractor is required to provide a minimum of one competent person serving exclusively as the SSHO. The SSHO is required to be onsite during all construction activity and is required to perform safety and occupational health management, surveillance, inspection, and safety enforcement. The SSHO is also required to prepare activity hazard analyses (AHA) prior to the start of new activities. The AHA's also need to be reviewed for compliance and used by the SSHO during the daily inspections to ensure implementation and effectiveness of the required safety and health controls for the work activity.

Table 1: Construction subsector incidence rates (per 100 workers) of nonfatal occupational injuries and illnesses by industry and case types, 2019 (BLS, *Injuries, Illnesses, and Fatalities*, 2020)

Industry	Total recordable cases	Total	Cases with days away from work	Cases with days of job transfer or restriction	Other recordable cases
Heavy and civil engineering construction	2.4	1.5	1	0.6	0.9
• Utility system construction	2.1	1.3	0.9	0.4	0.7
• Water and sewer line and related structures construction	3.5	2.3	1.6	0.6	1.2
• Oil and gas pipeline and related structures construction	0.5	0.3	0.2	0.1	0.2
• Power and communication line and related structures construction	2.5	1.6	1.1	0.5	0.9
• Land subdivision	1.7	1.3	0.3	1	0.3
• Highway, street, and bridge construction	3.4	2	1.2	0.9	1.3
• Other heavy and civil engineering construction	1.8	1.4	0.9	0.4	0.4

## **2.3 SAFETY CULTURE**

The term safety culture was first used by the International Atomic Energy Agency in its 1986 Chernobyl accident summary report (Roberts, 2021). It was a term used to describe how the thinking and behaviours of people in the nuclear plant contributed to the accident. The accident summary concluded that a low safety culture of the entire system was the root cause of the Chernobyl accident (Ukrainian Nuclear Society, 2019). Today the term safety culture is widely used and has gained more attention in the construction industry as companies realize the influence that workers attitudes towards safety has on the causes and effects of workplace incidents.

Having a positive safety culture is being proactive towards safety. It means that nothing takes precedence over safety under any circumstances, so the workforce does not feel that safety is an obstacle to getting work completed correctly and on time. A positive safety culture means that all personnel from senior leadership to the front line workers share the same responsibility for safety at work (Ransley, 2020). A negative safety culture contributes to the reactive vs. proactive safety culture. It means that most of the time one ends up having to react to a workplace incident because they are unable to prevent an incident from occurring. Often this can be result of feeling pressured to forego safety rules to meet deadlines.

In March of 2021, the Occupational Safety and Health Administration (OSHA) released a list of top 10 most frequently cited violations. The leading causes of death and injuries in the maritime industry (including maritime construction) are falling and drowning accidents, vehicular accidents and material handling accidents. According to OSHA statistics, slipping and falling into the water is one of the three leading causes of deaths in maritime industry. Some of the ways this accident can occur is by falling without a life vest, falling into the water, and being crushed due to lack of safe access to the barge or a worker falling when a corroded catwalk collapsed (Hofmann, n.d.). Leading indicators of safety culture may be a way to continue to reduce the accident rate by assisting safety professionals and management staff in identifying deficient areas in their safety programs before accidents occur. It is key that the safety programs that incorporate leading indicators can identify and measure which factors have a measurable impact on safety outcomes. These programs will also require buy-in from all involved and will take time before results can be measured, if measured at all (Hinze, et al., 2013).

## **3. RESEARCH METHODOLOGY**

This research used qualitative methods to understand the safety mind-set and level of commitment of USACE contractors and staff working in the construction of maritime projects. One of the purposes of qualitative research is to provide insights into the setting of a problem, and to uncover common trends. It is a way of gaining a deeper understanding of a topic (Saunders, et al., 2009). The research focuses on a small group of participants mostly with several years of experience constructing heavy civil engineering construction projects including maritime construction projects. The data will focus on their experiences, observations, and perceptions on safety. These interviews provide greater depth than a standard survey, allowing insight into the vast knowledge of the interviewee. Interviews were recorded on audio and transcribed. A survey was also considered for this research; however, the data collection would have been incomplete

and difficult to obtain as the contractors and personnel involved in marine construction available to the research team were limited.

Semi-structured interviews were chosen as the qualitative method for this research. This type of interview allows for it to flow like a natural conversation, the researcher was able to modify the questions to suit the interviewees specific experiences and insights into problems or issues that the questionnaire may not have revealed (Saunders, et al., 2009).

The candidates for this research were construction management professionals working in maritime construction and USACE staff with experience in maritime projects in their careers. The research will attempt to understand the safety culture of the workforce involved in these types of projects. The goal of the researcher is to learn of the experiences of the various interviewees and discuss how safety has changed throughout their careers. What have been some of the reasons for any safety issues that may have occurred and what have been some of the changes that have influenced safety in either a positive or negative way. The goal is to interview different candidates with extensive experience of maritime construction from both the contractor's side and the USACE side. Semi-structured interviews were conducted with twelve interviewees. Research shows that a full range of thematic discovery occurs almost completely within the first twelve interviews (Guest et al., 2006). Candidates were selected by the researcher based on availability and first-hand knowledge of maritime projects. Candidates had between 6 and 42 years of experience. A brief description of the interview candidates experience is provided below:

- Candidate 1: Chief of Safety for USACE, 6 years' experience
- Candidate 2: Project Manager, Mega Projects, USACE, 40 years' experience
- Candidate 3: Senior Construction Executive, USACE, 26 years' experience
- Candidate 4: Area Engineer, USACE, 22 years' experience
- Candidate 5: Area Engineer, USACE, 11 years' experience
- Candidate 6: Quality Assurance Executive, USACE, 30 years' experience
- Candidate 7: Chief of Operations, Private Industry, 15 years' experience
- Candidate 8: Senior Project Engineer, Private Industry, 35 years' experience
- Candidate 9: Project Manager, Private Industry, 6 years' experience
- Candidate 10: Lead Designer, USACE, 14 years' experience
- Candidate 11: Deputy Chief of Construction, USACE, 16 years' experience
- Candidate 12: Vice President, Private Industry, 35 years' experience

## **4. RESULTS AND DISCUSSION**

12 participants with varying levels of knowledge and experience of maritime construction were interviewed for this research. Interviewee experience ranged from 6 years to 42 years in the construction industry. The results of the thematic analysis are presented in this section.

### **4.1 THEMATIC ANALYSIS OF SEMI-STRUCTURED INTERVIEW DATA**

The semi-structured interview data was coded using open coding techniques. The responses for each interviewee were further analysed. This analysis indicated five major safety themes play significant roles in safety during construction of marine projects, these

are issues that need to be paid close attention to, and shown in Figure 1, as well as described in sub-sections below.



Figure 1: Causes of accidents in maritime construction projects

#### **4.1.1 Unforeseen Conditions**

Interviewee responses of safety issues that address unforeseen conditions were mentioned by 6 of 12 interviewees. Of note is that these unforeseen conditions were brought up mostly by the five interviewees with the most experience in marine construction. Most of the issues mentioned are also major issues in land construction but these dangers are elevated in marine construction. Some of the unforeseen conditions are shown below and in Figure 1.

- In dredging, can't close the beach so must be aware of public
- In dredging, can't be overseeing project entire time since dredging can be 24/7 work
- On a barge during dredging, oil spills occur and it is easier to fall or trip
- Environment issues such as weather, swell, winds, waves must be considered
- On water there's more sudden movement

#### **4.1.2 Complacency**

Interviewee responses of safety issues that address complacency were mentioned by 10 of 12 interviewees. Below are some reasons mentioned, and expanded further in the themes presented in Figure 1.

- Knowing the work involved and becoming comfortable
- Towards the end of a project when the project is near completion
- Difficult to maintain the same level of awareness throughout the entire construction project

#### **4.1.3 Training**

Training or the lack of was mentioned by all 12 in some capacity by the. When asked about marine construction safety, seven of the interviewees mentioned specific training in the marine construction projects is necessary, as well as specific training for other specialized work for example crane work and electrical.

#### **4.1.4 Support for Safety**

Support for safety was mentioned by five of the interviewees. Some of the issues mentioned were that there is a lack of time and funding for a thorough review of the safety specifications and other documents like the accident prevention plan and the various activity hazard analysis submittals. Another one is having the funding to be able to properly man the different construction projects with qualified personnel for proper oversight when construction is happening. Another reason that falls under support for safety is that throughout the years, personnel have been assigned with more tasks that don't necessarily pertain to safety during construction.

#### **4.1.5 Unprepared Crew**

Not being prepared was brought up by three of the interviewees. This is an issue for both the USACE and the USACE contractors. Accidents happen when employees don't have the proper training but also when they do not have the proper equipment for the job. It was also mentioned that employees do not prepare by discussing the specific work being performed on that day and addressing the issues that may arise.

## **4.2 SUGGESTIONS FOR IMPROVING MARINE CONSTRUCTION PROJECTS**

In this section thematic analysis was performed on the interviews to identify the different ways discussed by the interviewees that may help improve the safety during construction. The different methods mentioned were grouped into four main themes including ‘Develop/Tech/Train’, ‘Support for Safety’, ‘Communication’ and ‘Preparation’. Figure 2 shows codes developed during the analysis and categorised under these major themes.

### **4.2.1 Develop/Teach/Train**

Developing, teaching, and training was a major theme amongst the interviewees. It was mentioned in some form by all 12 interviewees to improve maritime construction safety. It was mentioned that more site-specific training would be of great benefit, especially in the marine construction projects, other site-specific training mentioned was trenching, electrical, cranes, and vertical construction. Different stages of the construction project were mentioned as opportunities to develop and train employees, including in the development of specifications by training new employees how to read and understand the specifications, training to understand the plans to know the sequence of work and during construction, development of new employees by experienced personnel through mentoring out in the field during construction. Figure 2 displays all unique responses by interviewees that were grouped into this theme. Most of the interviewees recommended that all construction personnel should focus on safety as the top priority. At a minimum have had a safety course for example the OSHA 30 course. The interviewees stressed continued training. A recommendation was also that with so many experienced personnel onsite both from the USACE and contractors, to recommend that different workers discuss a safety topic that they are familiar with and to include workers in the conversation and encourage safety discussions.

### **4.2.2 Preparation**

Preparation was the second most discussed issue for improvement and was discussed by all 12 interviewees. Knowing the safety requirements for the work ahead was a major topic of conversation. Knowing the work ahead leads to being proactive in anticipating possibilities for safety hazards. Inspecting equipment and maintaining it in good condition as well as preparing with the correct tools were all topics in preparation for a safe construction project.

### **4.2.3 Communication**

Communication is a major topic for safety in all construction sites. This includes the marine industry and can be a much more significant factor in maintaining safety. In marine construction projects, communication with the public and the public entities for assistance was mentioned by all USACE contractors interviewed. Also mentioned was communicating with radios or being with someone that has a radio and always having a direct line of sight due to the large equipment used. Figure 2 includes the different ways the interviewees addressed communication for improving safety.

### **4.2.4 Support for Safety**

Support for safety was mentioned as a major reason for having safety issues and it’s also a major way that safety may be improved. Ten percent of the responses included supporting safety from supporting the safety program for the company to funding for

safety oversight. This includes having the safety office being involved in all phases of the project from development to completion.

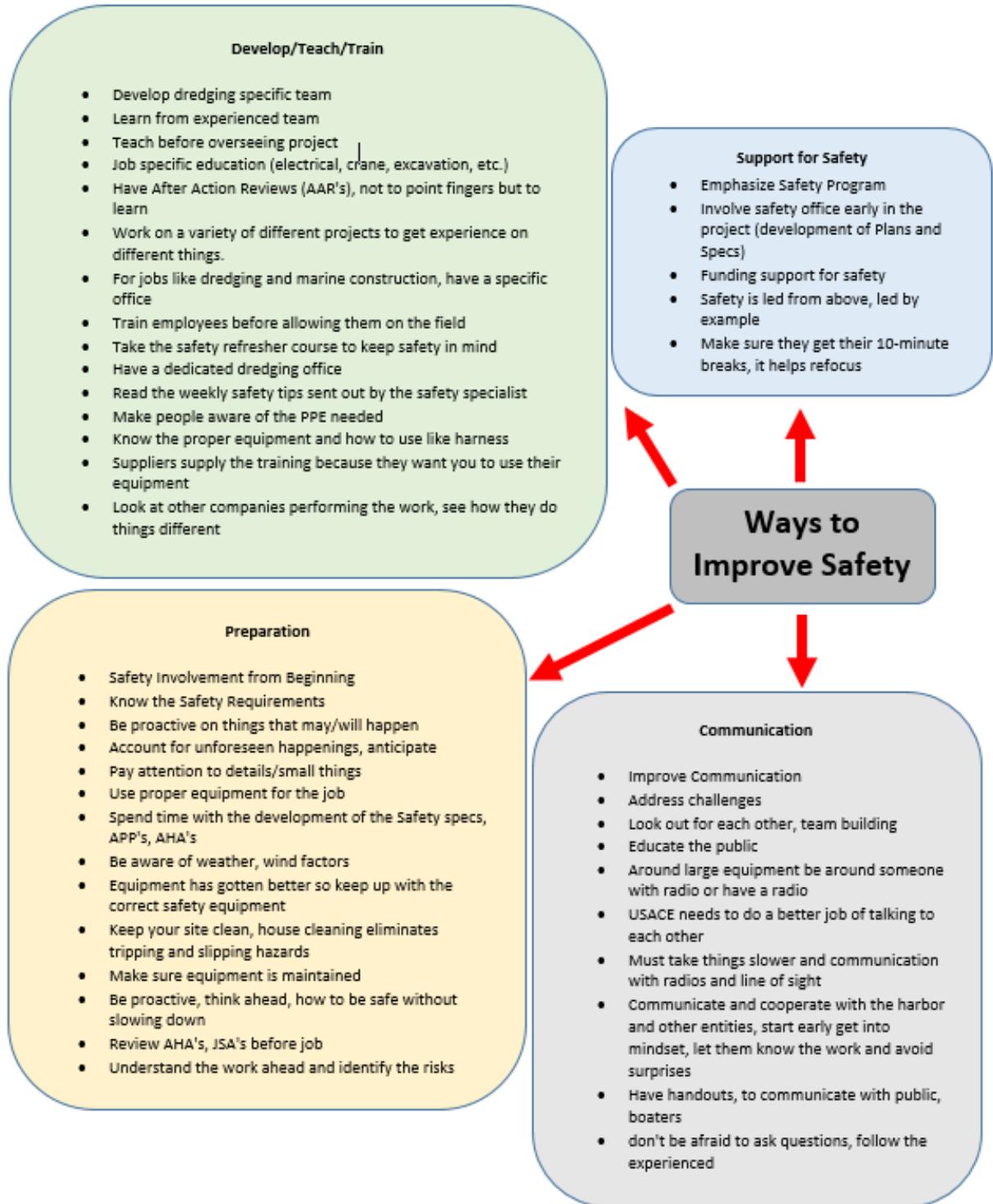


Figure 2: Four basic elements of reading ease

#### 4.2.5 Best Practices

A best practices safety guide for marine construction may prove beneficial for both USACE and contractor staff. The guide may help explain some of the hazards to

anticipate on such projects. Table 2 is a list of combined comments and recommendations for a safe project, beginning to end. This table was developed based on some of the most critical and repeated comments from the interviews. Further research is needed to validate this table and develop a framework or a guide to make improvements. Lack of sufficient data related to maritime construction projects is an impediment to drawing meaningful conclusions relating their frequency. It is important that OSHA data be further segmented to show safety incidents on maritime construction projects.

Table 2: Comments and recommendations for safe maritime projects

Phase	Comments	Recommendations
Planning and Design	<ul style="list-style-type: none"> <li>Lack of Support for Safety, safety office was not involved throughout project, so not enough of thorough review for plans and specifications. USACE safety team has too many tasks.</li> </ul>	<ul style="list-style-type: none"> <li>Safety is led from above, led by example. Emphasize Safety Program. Need to support safety by funding. Involve safety office early and throughout project from development of Plans and Specs to construction completion. Develop Dredging Specific Team, develop and train. Take safety refresher course to keep safety in mind.</li> </ul>
Pre-Construction	<ul style="list-style-type: none"> <li>Lack of anticipation due to not having job specific training, not understanding job ahead. Lack of job specific experience. New employees are not spending enough time following the experienced, to learn from experienced personnel. Don't have the proper PPE, equipment, and tools. Equipment not well maintained. Need to have thorough review of APP's, AHA's.</li> </ul>	<ul style="list-style-type: none"> <li>Take time to prepare. Improve Communication and address the Challenges of specific job ahead. Look out for each other have team building activities. Be prepared, be proactive. Have job specific education (electrical, crane, dredging, etc.). Don't be afraid to ask questions and follow the experienced personnel while learning. Use proper equipment for the job and keep it well maintained, and know the Safety Requirements study plans/specs, take necessary time to review APP's, AHA's.</li> </ul>
Construction	<ul style="list-style-type: none"> <li>In dredging most times, can't close the beach so must be aware of public. Public doesn't know of hazards during construction.</li> <li>In dredging, there's not enough oversight, difficult to oversee project entire time since many times dredging is 24/7 work, to complete within small window due to environmental concerns. 24/7 work also brings issue of fatigue.</li> </ul>	<ul style="list-style-type: none"> <li>Communicate with public, have handouts. Communicate and cooperate with the Harbour and other entities that can help with public safety. Start communication early in project to get into mind-set, let different public agencies know ongoing work to avoid surprises.</li> <li>Oversee construction at different times to see how construction is being performed at different times. Maintain awareness of workers that may look fatigued. Do not be afraid to ask questions.</li> </ul>

Phase	Comments	Recommendations
	<ul style="list-style-type: none"> <li>On a barge during dredging there's sudden movement, there's moisture on the deck, slippery surfaces, there may be oils, beware of slips, trips, falls. Possibility of falling in the water and getting between barges. Marine construction equipment is large, there's more opportunity of getting hurt.</li> <li>In marine environment hazards are on a different level, Environment-weather, swell, winds, waves. Need to be aware of changing conditions. Foggy mornings and nights, have high safety exposure.</li> <li>In dredging complacency is a factor due to same contractors being awarded the contracts, they build habits that may not be good and may not look at things as carefully as they would if they were doing the project the first time. Also, towards the end when project is near completion, contractor becomes complacent.</li> </ul>	<ul style="list-style-type: none"> <li>Keep your site clean, house cleaning helps eliminates tripping and slipping hazards. Around large equipment be with someone with radio or have a radio. Need to take things slower and communicate and maintain line of sight. Pay attention to details and small things and anticipate.</li> <li>Be aware of weather, wind factors and rapidly changing conditions. Make sure weather is part of look ahead schedule.</li> <li>Team on both contractor and USACE side have employees with different levels of experience, have different team members discuss safety to keep them engaged.</li> </ul>
Post-construction	<ul style="list-style-type: none"> <li>Learn from previous experiences and make changes necessary</li> </ul>	<ul style="list-style-type: none"> <li>Develop an after-action report requirement to understand the positives and negatives. What went well and what didn't, improve upon it. Look at other companies performing similar work, see how they do things different.</li> </ul>

## 5. CONCLUSIONS AND RECOMMENDATIONS

Responses from the interviewees on hazards of maritime construction are many of the same as traditional heavy civil construction projects. Maritime construction combines these hazards with the hazards of working on a floating vessel. Weather becomes a much more critical part of construction when working on the water, due to swells and waves which increase risks. Some of these maritime construction projects like dredging are 24 hour, seven days a week work due to the short dredging window given because of weather and environmental factors, the issue of fatigue is a major concern.

A common hazard of maritime construction is the public. Being mindful of the public and paying close attention is important. In land-based construction, the site can be fenced off most times. On the water many times the public doesn't have the awareness of the hazards of the large equipment being used to dredge. Many times, equipment is underwater and

out of sight for example the anchor wires which can be spread over 1000 feet apart. Much of the maritime crew and staff have worked on maritime construction for many years, this brings the issue of complacency, knowing the job and feeling that the job can be done very easily can add risk. The marine industry believes that more rules, regulations, and procedures are unlikely to improve safety performance (American Bureau of Shipping, n.d.).

Awareness during construction was also high on ways to improve safety. Understanding that maritime projects are some of the most dangerous. Communication with local officials to help engage the public and make them aware of the risks of the work. Be aware of the public, every job is different, highlighting any risks of public interference was also brought up by interviewees with the most marine construction experience. Contractor employee involvement in safety, empowering employees to give feedback through after-action reports (AAR's) was a great way of being able to receive the feedback necessary to improve. Effective communication was something discussed by all experts. Communicating in all stages of the project, beginning with communicating and agreeing on the safety specifications and all documentation, communicating about the schedule and type of work that will be going on, also recommending that most of the construction workers use a radio to effectively communicate between each other, and communication after the project is complete and having discussions about what went right and what could be improved.

The research team interviewed 12 highly experienced USACE staff and contractors in marine and heavy civil construction projects. During the interview they were asked to comment on issues experienced and recommendations to mitigate the issues related to maritime safety. Suggestions were shared by the interviewees on how to improve safety during all phases of a project from the planning and design phase to the post-construction phase. For example, one interviewee mentioned that the safety office was not part of the specification review before advertisement, therefore, the safety specifications were not reviewed by the safety experts before the contract was awarded. A recommendation shared by the interviewees was that the safety office should be part of the team in every phase of the project from beginning to end. This would allow safety experts to perform the following during the separate phases:

- Planning and Design Phase - Review plans and specifications before contract advertisement for deficiencies.
- Pre-construction phase - Review contract documents for example accident prevention plans and activity hazards analysis. Perform site investigations before construction begins to look for and anticipate construction hazards.
- Construction phase - Provide Safety expert oversight during construction.
- Post-construction - Discuss the overall project in the form of after-action reviews to understand things that went well and things that did not go well for improvement recommendations.

## 6. REFERENCES

American Bureau of Shipping, n.d. Safety and Human Factors [WWW Document]. [Online] Available from: <https://ww2.eagle.org/content/dam/eagle/rules-and-resources/Safety-and-Human-Factors-Design/management-organization/incident-investigation/Safety%20Culture.pdf> [Accessed 30 March 22].

- Cruickshank, I. and Cork, S., 2005. *Construction Health and Safety in Coastal and Maritime Engineering*. Thomas Telford.
- Ek, Å., Runefors, M. and Borell, J., 2014. Relationships between safety culture aspects - A work process to enable interpretation. *Marine Policy*, 44, pp. 179-186
- Experts, T.E.I., n.d. Building Safety Culture During the Coronavirus Pandemic [WWW Document]. [Online] Available from: <https://www.triumvirate.com/blog/why-building-safety-culture-during-the-coronavirus-pandemic-is-more-important-than-ever> [Accessed 30 March 22].
- Guest, G., Bunce, A. and Johnson, L., 2006. How many interviews are enough? An experiment with data saturation and variability. *Field Methods*, 18(1), pp. 59-82.
- Hinze, J., Thurman, S. and Wehle, A., 2013. Leading indicators of construction safety performance. *Safety Science*, 51(1), pp. 23-28.
- Hofmann, n.d. Three Common Causes of Accidents That Lead to Maritime Workers' Deaths and Injuries [WWW Document]. [Online] Available from: <https://www.hofmannlawfirm.com/library/three-major-causes-of-maritime-workers-fatalities.cfm> [Accessed 29 March 22].
- Mehata, K.M., Shankar, S.K., Karthikeyan, N., Nandhinee, K. and Hedwig, P.R., 2019, IoT based safety and health monitoring for construction workers. In: *2019 1<sup>st</sup> International Conference on Innovations in Information and Communication Technology (ICIICT)*, pp. 1-7. IEEE.
- Marefat, A., Toosi, H. and Hasankhanlo, R.M., 2018. A BIM approach for construction safety: Applications, barriers and solutions. *Engineering, Construction and Architectural Management*, 26, pp. 1855-1877
- Ransley, A., 2020. 7 Characteristics of a Positive Workplace Culture [WWW Document]. [Online] Available from: <https://www.linkedin.com/pulse/7-characteristics-positive-workplace-culture-andrew-ransley> [Accessed 30 March 22].
- Roberts, H., 2021. How to Improve and Promote Safety in Construction [WWW Document]. [Online] Available from: <https://www.ehstoday.com/construction/article/21165175/how-to-improve-and-promote-safety-in-construction> [Accessed 30 March 22].
- Saunders, M., Lewis, P. and Thornhill, A., 2009. *Research methods for business students*, 5<sup>th</sup> ed. Prentice Hall.
- Ukrainian Nuclear Society, 2019. Low safety culture of the entire system - the cause of the Chernobyl accident [WWW Document]. [Online] Available from: <https://ukrns.org/en/publications/item/1272-low-safety-culture-of-the-entire-system-the-cause-of-the-chernobyl-accident> [Accessed 30 March 22].