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OCCUPATIONAL HEALTH AND SAFETY MANAGEMENT FRAMEWORK FOR SHIPYARD INDUSTRY WORKERS IN BATAM CITY INDONESIA

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Abstract: The study was conducted in three phases; the first phase involved distributing two sets of questionnaires to all samples. The first set analyzed workers' awareness levels of the OHS program. For the second set, the questionnaire aimed to analyze the level of OHS management implemented. The second phase was conducted qualitatively using two rounds of the Delphi technique involving 14 experts and document analysis to analyze problems arising in implementing the existing OHS framework and identify essential elements and their criteria. Finally, the proposed framework was validated by seven experts based on their opinions. The study results indicate that (1) Workers' awareness levels regarding OHS in Batam are high. (2) The level of OHS management implementation in Batam is also high. (3) There are six essential elements in the OHS management framework: design and implementation involving all parties, OHS management compliant with ISO 45001:2018 standards based on Government Regulation Number 50/2012, supervision, disciplinary enforcement, and establishment of a dedicated OHS department in each company. (4) This study successfully produced a new framework, namely establishing a dedicated OHS department for managing worker health and safety in the shipbuilding industry in Batam, Indonesia.

Keywords: Safety; framework; shipyards; worker health; shipbuilding industry

INTRODUCTION

Indonesia, as one of the largest maritime countries in the world, has great potential to advance the maritime sector as one of the backbones of the national economy. With a coastline length of about 81,000 kilometers, Indonesia occupies the second position after Canada as the country with the longest coastline in the world. This potential is further strengthened by President Joko Widodo's statement that Indonesia's vast maritime area of up to 70 percent has the economic potential of the maritime sector of 1.2 trillion US dollars per year, while being able to absorb up to 40 million workers. One of the maritime sectors that has bright prospects is the shipping industry (Bachtiar, Marimin, Adrianto, & Bura, 2021).

According to the Ministry of Industry, there are around 200 shipping and shipyard industry companies in Indonesia. This industry not only plays a role in meeting the needs of the domestic market but also has great potential for export. In 2017, shipbuilding orders reached 218,300 gross tonnages (GT), with 83 percent of this to meet domestic demand and the rest for export (Bachtiar et al., 2021). The Government of Indonesia continues to encourage the development of this sector by setting a vision to make Indonesia one of the largest shipping industry leaders in Asia and the world.

One of the cities that is the center of the development of the shipping industry is Ba-tam, which is located in the Riau Islands Province. Of the 57 shipyards spread throughout the Riau Islands Province, 52 are in Batam. The city was chosen as the location of the study because of its strategic geographical position, directly adjacent to Singapore and Malaysia and located in the Strait of Malacca, one of the busiest maritime lanes in the world. In addition, Batam has been used as an industrial area since 1973 through Presidential Decree No. 41 of 1973, with divisions into light and heavy industrial areas. The shipyard industry is part of heavy

industry that has an important role in supporting regional and national economic growth (Akbar, Oloan, & Gurning, 2018).

However, the shipping industry is a sector with a high risk to occupational safety and health (K3)(Hendiani & Wediawati, 2023). Activities such as working at heights, confined spaces, hot areas, using high pressure tools, welding, heavy lifting, and radiography tests put workers at risk of injury, illness, and even death. According to (Iswanto, Soerahman, Naim, & Saputra, 2023), worker productivity is greatly influenced by the level of K3 applied in the workplace. The higher the level of occupational safety, the lower the risk of accidents, illnesses, or deaths, thus having a posi-tive impact on the company's productivity. (Iswanto et al., 2023) also proved that there is a positive relationship between the implementation of K3 and increased work productivity. Therefore, (Aven, 2016) said that good job risk management can be a strategic investment to im-prove organizational performance.

Based on Government Regulation No. 50 of 2012 and the international standard ISO 45001:2018, the K3 management system must be implemented by every company as part of the overall organizational management system. The goal is to prevent and reduce occupational accidents and illnesses, create a safe, comfortable, and efficient work environment, and increase worker productivity. Unfortunately, the implementation of K3 in the field still faces various challenges(Williamson, 2019). BPJS Employment data shows that the number of work accidents in Indonesia is still high, including in the shipyard sector in Batam. In addition, the results of the study show that human factors and the work environment are the main causes of work accidents.

Human factors include lack of discipline, violations of safety procedures, and lack of workers' understanding of the importance of K3. Meanwhile, work environment factors include unsafe workplace conditions, lack of supervision, and lack of safety training. This is reinforced by research by (Iswanto et al., 2023) which shows that some workers do not use personal protective equipment (PPE) consistently, and some even joke in high-risk work areas. (ILO, 2023) also found that inappropriate worker behavior is influenced by internal (motivation, perception, attitude) and external (supervision, training, regulation) factors(Shank, Boynton, & Zmud, 1985).

The implementation of K3 is not only the responsibility of workers, but also company management. According to the Regulation of the Minister of Manpower and Transmigration No. PER-01/MEN/I/2007, the purpose of the implementation of K3 is to achieve "zero accidents" or zero accidents in the workplace. This concept is not only a target for the company, but also a measure of the success of the implementation of the K3 management system (Swatika, Wibowo, & Abidin, 2022) stated that the implementation of K3 is based on three main reasons, namely moral, legal, and economic. In terms of morality, every worker has the right to occupational safety and health protection in accordance with Law No. 13 of 2003. From a legal point of view, companies that ignore K3 can be sanctioned in accordance with applicable laws. Meanwhile, from an economic perspective, the implementation of K3 can reduce costs due to work accidents, insurance claims, and productivity losses.

This study aims to analyze workers' awareness of the importance of K3, evaluate the implementation of K3 in the shipyard industry in Batam, identify obstacles in the implementation of the K3 system, and design an adaptive and effective K3 framework. Thus, it is expected to improve the culture of work safety, support worker productivity, and encourage the realization of a safe and healthy work environment in the Indonesian ship-ping industry(Akbar et al., 2018). This study will make a significant contribution to the government, companies, and workers in improving the quality of K3 management in the maritime sector, especially in the Batam region.

METHODS

This study uses a mixed methods approach which consists of two main phases, namely the quantitative phase and the qualitative phase. This approach was chosen to obtain a more comprehensive, holistic, and relevant understanding of worker awareness and the application of Occupational Safety and Health (K3) in

the shipyard industry in Batam City, Riau Islands Province, Indonesia. The quantitative phase aims to measure the level of worker awareness and evaluate the implementation of K3 systematically, while the qualitative phase is used to identify issues related to the implementation of K3 (Basumatary & Maity, 2023) and design an adaptive and effective K3 framework.

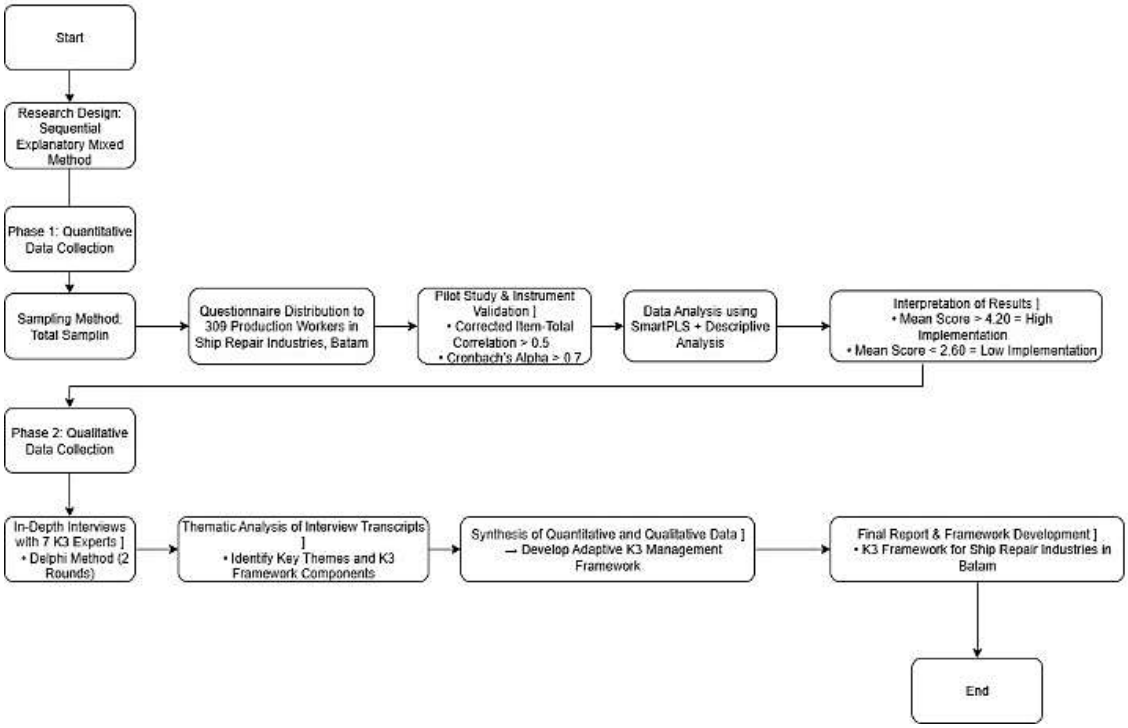

FIGURE 1

RESEARCH DESIGN

Design Research

The research design used is Sequential Explanatory Strategy, which is a mixed methods approach where quantitative data is collected and analyzed first, then followed by the collection and analysis of qualitative data to provide a more in-depth explanation of the quantitative results obtained. This approach allows researchers to understand the phenomenon more comprehensively by combining measurable statistical data and descriptive contextual data.

Quantitative Data Collection

Quantitative data collection was carried out through a closed questionnaire prepared based on previous literature and research and has been tested for validity and reliability. The questionnaire consists of three main sections, namely:

- Demographics section: includes information such as age, gender, length of work, and position of worker.
- Human factors: related to work attitude, K3 knowledge, discipline in using per-sonal protective equipment (PPE), and behavior at work.
- Work environment factors include
  - including the physical condition of the workplace,
  - availability of safety facilities,
  - and the implementation of fixed procedures (SOPs) in the shipyard environment.

Each item in the questionnaire uses a 5-point Likert scale, namely: 1 (Very Poor/Very Low), 2 (Poor/Low), 3 (Acceptable/Medium), 4 (Good/High), and 5 (Very Good/Very High). This scale is used to

measure respondents' perception of the aspects of K3 that are the focus of the research(Nimmi, Tridoyo, Gena, & Arief, 2020).

The research population consisted of 309 workers in the production section of the shipyard in Batam. Given the relatively small and homogeneous population size, total sampling is used, which is an approach that involves all members of the population as a sample(Avella, 2016). In addition, this approach is also carried out to improve the validity and reliability of the data collected.

Instrument Validity and Reliability Test

Before the questionnaire is widely used, a pilot study is conducted in several ship-yard companies to evaluate the suitability of the instruments and correct potential errors or ambiguities in the questions. The validity test is performed by calculating the value of Corrected Item-Total Correlation, and the item is considered valid if the value greater than 0.5. The reliability test is performed by calculating the Cronbach's Alpha coefficient, and the instrument is considered reliable if the Cronbach's Alpha value exceeds 0.7. The test results showed that all items had a Cronbach's Alpha value above 0.9, indicating a very high level of reliability(Putra, Madlaim, & Hariyono, 2024).

Quantitative Data Analysis

Quantitative data were analyzed using SmartPLS software to evaluate the measurement structure and relationship model between variables. Descriptive analysis was carried out to describe the level of awareness of workers towards K3, as well as to evaluate the application of K3 in shipyards. The average score for each item in the questionnaire was used as an indicator of the level of awareness and implementation of K3. If the average score of an item exceeds 4.20, then the item is considered to contribute to very high level of awareness or K3 implementation(Wong, Anwar, Debnath, Hamid, & Izman, 2021).

Qualitative Data Collection

The qualitative phase aims to delve into quantitative findings and design an adaptive K3 framework. Data was collected through in-depth interviews with 14 K3 experts with experience in the field of occupational safety and health in the maritime industry. The two-round Delphi technique is used to obtain input from experts in establishing the ideal components and criteria of the K3 framework.

The selection of experts is carried out by purposive sampling, with the main criterion being having at least 5 years of experience in the application of K3 in high-risk industrial sectors, especially in shipyards. Delphi was first used to gather the initial opinions of experts on the essential elements of the K3 framework. The second Delphi is used to refine and reach consensus on these elements(Avella, 2016).

Qualitative Data Analysis

Interview transcripts are analyzed using thematic coding to generate key themes relevant to the research objectives. This process involves identifying patterns, categories, and themes that emerge from qualitative data. The results of this analysis are then used to de-sign a K3 framework that is tailored to field conditions and the needs of the shipyard industry in Batam.

RESULT

At this stage, data was collected by distributing questionnaire instruments to ship-building industry workers in the production department. Initially, 302 questionnaires were conducted, but only 294 (97.53%) were returned. From the data collected, an analysis was carried out on the purpose of the research, namely the Awareness of Shipyard Workers in Batam City towards Occupational Health and Safety Management (Williamson, 2019).

At this stage, the goal to be obtained is to analyze the level of awareness of shipyard workers in Batam City regarding the importance of implementing occupational health and safety management. This was done to find out if the workers in the production department at the shipyard had a good awareness of occupational health and safety(Hendiani & Wediawati, 2023).

To make this research more comprehensive, each element was analyzed based on the mean score (mean value), as shown in Table 1.

TABLE 1 Interpretation Score Min

Level of Score Category	Interpretation

1.00 – 1.79	Very bad/Very low
1.80 – 2.59	Poor/Low Acceptable/Medium
2.60 – 3.39	Good/High
3.40 – 4.19	Very good/Very high
4.20 – 5.00	

First Element: Discipline in Using PPE

Through the distribution of the questionnaire that was conducted to all respondents, important results were obtained to find out the level of discipline of shipyard workers, especially in the production department, in using personal protective equipment while carrying out their work. The results of the data analysis on this first element are as can be seen from Table 2:

TABLE 2 Disciplinary Elements Using PPE

No	Statement	Skor Min	Interpretation
1	I wear gloves while working in the field	3.64	High
2	I wear safe shoes at work that are made of leather and flame retardant	3.79	High
3	I wear a mask while working where it is required to wear a mask	3.81	High
4	I wear work clothes while working	3.68	High
5	I wear a hat to protect my head and hair while working	3.61	High
Average Min Score		**3.71**	High

FIGURE 2 Score Detail Minimal Disciplinary Elements Using PPE

Of the five items in this first element, it is stated that the highest score is on the third item, "I wear a mask when I work where I want to wear a mask", with a score of 3.81. Then followed by the second item, "I wear safety shoes at work made of leather and fire retardant" (3.79), has a high meaning. Then followed by the fourth item, "I wear work clothes at work" (3.68). The same goes for the first item, "I wear gloves when working in the field" (3.64), and the fifth item, "I wear a hat to protect my head and hair while working" (3.61), which has a high average.

These values show that workers in shipyards, especially in the production sector, are highly aware of the discipline of using personal protective equipment when working. They are aware that indiscipline using PPE will have fatal consequences when carrying out their work. It can be noted that the high awareness or high level of discipline of ship-yard workers in Batam City is a positive thing in protecting themselves when carrying out the work that is their duty.

Based on the results of the data analysis on this first element, it can be stated that workers at shipyards in Batam City, especially those working in the production department, are highly aware of enforcing the discipline of using PPE. This means that they al-ways use PPE at work and can discipline themselves to always use PPE at work. This is evidenced by the average mean score of 3.71 in Table 3.

TABLE 3 Disciplinary Elements Using PPE

No	Statement	Skor Min	Interpretation
1	I wear gloves while working in the field	3.64	High
2	I wear safe shoes at work that are made of leather and flame retardant	3.79	High
3	I wear a mask while working where it is required to wear a mask	3.81	High
4	I wear work clothes while working	3.68	High
5	I wear a hat to protect my head and hair while working	3.61	High
Average Min Score		**3.71**	High

FIGURE 3 Score Detail Minimal Elements of Attitudes in the Workplace

Second Element: Attitudes in the Workplace

Through the distribution of the questionnaire that was conducted to all respondents, important results were obtained in an effort to find out the level of ethics of shipyard workers, especially in the production department when they are in the environment where they work and in the middle of carrying out their work. The results of the data analysis on this second element are as can be seen from Table 4.

TABLE 4 Elements of Attitudes in the Workplace

No	Statement	Score Min	Interpretation
1	I prepare all safety equipment before work	3.57	High
2	I return the equipment to its original place after work	3.46	High
3	In my opinion, thinking about safe working methods should be done before work	3.7	High
4	In my opinion, adhering to OSH regulations is important even though it sometimes hinders work	3.82	High

5	I don't get my colleagues to talk and joke while doing work for unnecessary things	3.67	High
6	I don't carry a mobile phone while I'm in the work area	3.6	High
7	I don't handle a mobile phone while working	3.6	High
Average Min Score		**3.63**	**High**

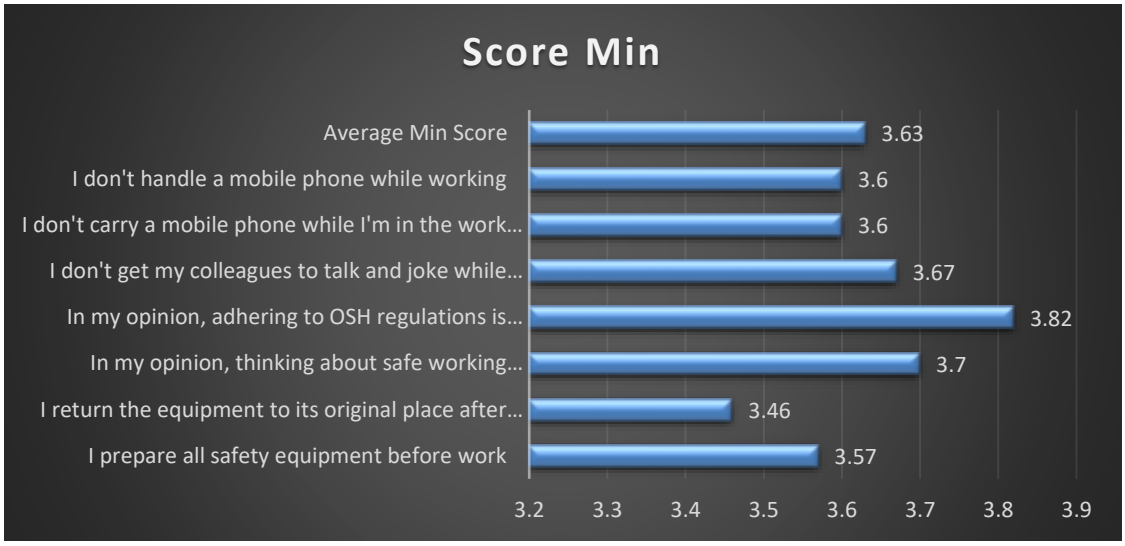

FIGURE 4 Score Detail Minimal Elements of Knowledge About K3

Of the seven items in this second element, it is stated that the highest score is on the fourth item; "In my opinion, adhering to OSH regulations is important even if it some-times interferes with work", with a score of 3.82. The third item, "In my opinion, thinking about safe working methods should be done before work" (3.7), has a high meaning. Then followed by the fifth item, "I don't invite colleagues to talk and joke while doing work for unnecessary things" (3.67), has a high meaning. Then followed by the sixth item, "I don't carry my phone while I'm in the work area," and seventh, "I don't control my phone while I'm working", which has the same score of 3.6, which is also high. The same goes for the first item, "I prepare all the safety equipment before work" (3.64), and the second item, "I return the equipment to its original place after work" (3.46), which has a high average.

The analytical value of this second element shows that workers in shipyards, especially in the production sector, have a high awareness of their attitudes when in the environment where they work. They are aware that being right, kind, and not rushed at work and when carrying out work will keep them away from all forms of work risks that can threaten their health and safety. It can be seen that the high awareness or high awareness of shipyard workers in Batam City is a positive thing in protecting themselves when carrying out the work that is their obligation.

Based on the results of the data analysis on this second element, it can be stated that employees in shipyards in Batam City, especially those working in the production department, are highly aware of their workplace behavior. This means that they always take care of themselves and their attitude at work so that they are on the lookout for unwanted things and all forms of risks that lurk if they are negligent.

Third Element: Knowledge of K3

Through the distribution of the questionnaire conducted to all respondents, important results were obtained in an effort to find out the level of knowledge of shipyard workers, especially in the production department, on the principles and program of Occupational Health and Safety (OSH) in their workplaces and during the conduct of work [7]. The results of the data analysis on this third element are as can be seen from Table 5.

TABLE 5 Elements of Knowledge About K3

No	Statement	Score Min	Interpretation
1	I comply with the relevant regulations of OSH that apply where I work	3.69	High
2	I attended K3 training held by companies and external parties	3.69	High
3	I obey every sign, and the warning signs must not be violated	3.76	High
4	I am aware that all work safety and personal protection devices are important	3.65	High
5	I am aware that the chain of restrictions that are prohibited from entering must be followed	3.67	High
Average Min Score		**3.69**	**High**

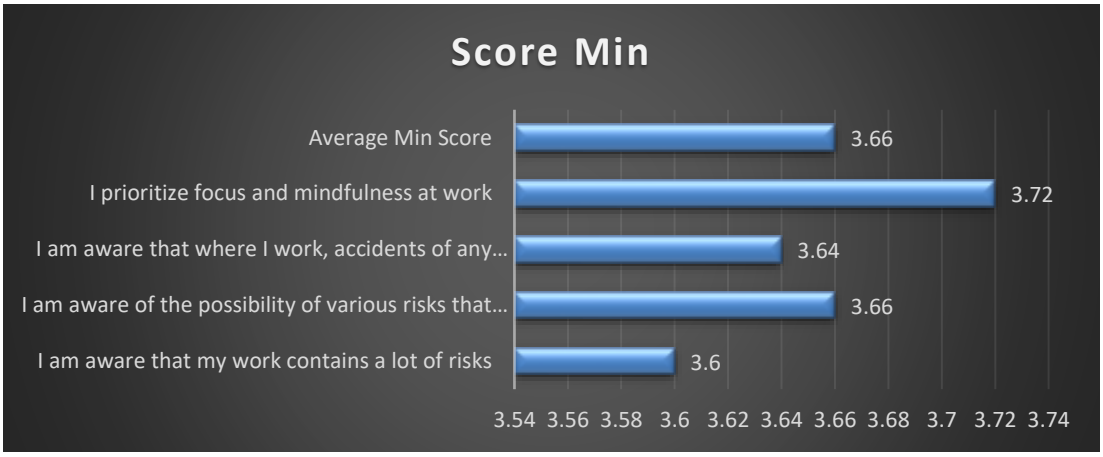

FIGURE 5 Score Detail Minimal Elements of Prevention of Occupational Accidents and Diseases

Of the five items in this third element, it is stated that the highest score is on the third item, "I obey every sign and warning sign must not be violated", with a score of 3.76. This was followed by the first item "I comply with the OSH related regulations used where I work" and the second item "I participated in OSH training held by the company and ex-ternal parties" which both had a high score of 3.69. This is followed by the fifth point, "I am aware that the barrier chain that is prohibited from entering must be observed" (3.67), which also means high. The same is true for the fourth item, "I am aware that all work safety and personal protective devices are important" (3.65), which has a high average value.

The analytical value of this third element shows that workers in shipyards, especially in the production sector, have a high awareness of Occupational Health and Safety (OHS). They are aware that OSH rules must always be followed, whether for warning signs that may be violated or not. This includes their heightened awareness of the knowledge and importance of all security and personal protection tools for them. It can be noted that the high awareness or high knowledge of the shipyard workers in Batam City is a positive thing in protecting themselves when carrying out the work that is their duty.

Based on the results of data analysis on this third element, it can be stated that ship-yard workers in Batam City, especially those in the production department, have a high awareness of their knowledge of K3. This means that they always comply with every warning given and follow the training related to the OHS program. This is evidenced by the average mean score of 3.69 in Table 4.

Fourth Element: Prevention of Occupational Accidents and Diseases

Through distributing the questionnaire to all respondents, important results were obtained to determine the extent of prevention from the risk of occupational accidents and diseases in their workplace and during work performance. The results of the data analysis on this fourth element are as can be seen in Table 6.

TABLE 6 Elements of Prevention of Occupational Accidents and Diseases

No	Statement	Score Min	Interpretation
1	I am aware that my work contains a lot of risks	3.6	High
2	I am aware of the possibility of various risks that threaten my health and safety at work	3.66	High
3	I am aware that where I work, accidents of any kind can easily happen	3.64	High
4	I prioritize focus and mindfulness at work	3.72	High
Average Min Score		**3.66**	**High**

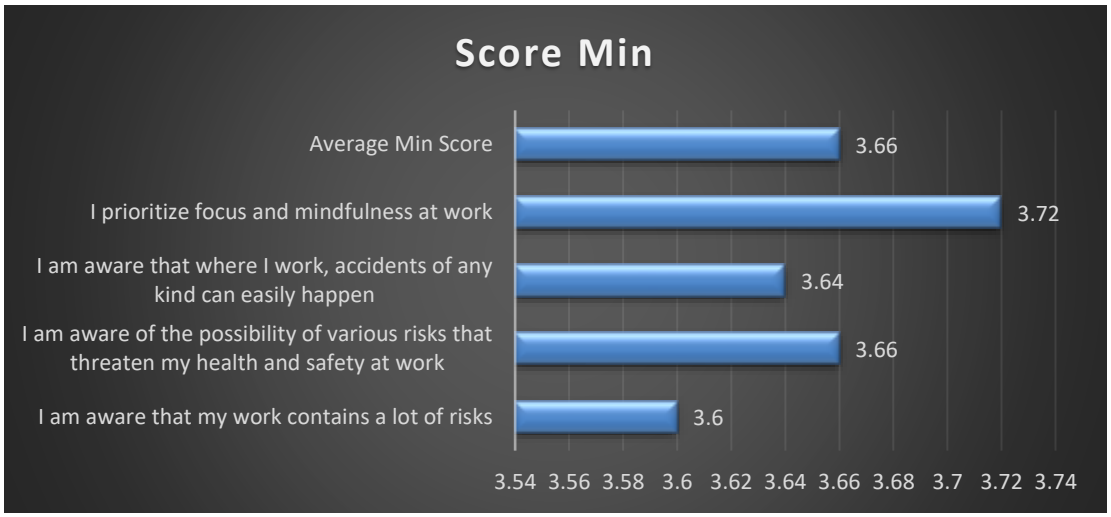

FIGURE 6 Score Detail Minimal Elements of Prevention of Occupational Accidents and Diseases

Of the four items in this third element, it is stated that the highest score is on the fourth item, "I prioritize concentration and caution at work", with a score of 3.72. Then followed by the second item, "I am aware of possible risks that threaten my health and safety at work", which has a high score of 3.66. Then, followed by the third item, "I am aware where I work, and the misfortune of any kind easily happens" (3.64), which is also high. The same is true for the first item, "I am aware my work contains a lot of risk" (3.6), which has a high average value.

The analytical value of this fourth element shows that workers in shipyards, especially in the production sector, have a high awareness of preventing all things related to the risk of occupational accidents and diseases. They know that their work contains high risks that are constantly threatening their health and safety. In addition, they are also aware that high concentration and vigilance are needed when carrying out their work. It can be noted that the high awareness of the prevention of all risks of occupational accidents and diseases by shipyard workers in Batam City is a positive thing in protecting themselves when carrying out the work that is their duty.

Based on the results of data analysis on this fourth element, workers in shipyards in Batam City, especially those in the production department, are highly aware of preventing occupational accidents and diseases. This means that they are aware of the importance of occupational health and safety (K3).

DISCUSSION

Analysis of the Awareness Level of Shipyard Workers in Batam City on Occupational Health and Safety Management. The awareness of shipyard workers in Batam City, especially those in the production department, regarding the importance of occupational health and safety principles is considered high.

In an effort to obtain these findings, the first questionnaire that was distributed consisted of 8 elements, namely the element of discipline in using PPE, the element of attitude in the workplace, elements of knowledge about occupational health and safety, elements of prevention, occupational accidents and diseases, elements of a good workplace, elements of health availability facilities, elements of supervision in

the implementation of occupational health and safety, and finally, elements of work procedures according to SOPs.

According to many researchers, such as (Mada, 2016),(Garg, Jindal, Bhatia, Johari, & Gupta, 2023), and (Hendiani & Wediawati, 2023), discipline in using PPE is very important in upholding occupational health and safety. In line with that, shipyard workers in Batam City, especially those in the production department, are highly aware of the need to strengthen the discipline of using PPE. That is, they always use PPE at work and can discipline themselves to always use PPE at work.

Likewise, workers' attitudes in the workplace are different. The principle of upholding occupational health and safety (Ogundeji et al., 2021)emphasizes that employees' attitudes at work also determine health and safety. Shipyard workers in Batam City, especially those working in the production department, are highly aware of their workplace behavior. This means that they always take care of themselves and their attitude at work to be aware of the un-desirable and all the risks that lurk if they fail.

Regarding employees' knowledge of occupational health and safety, (Saifuddin, Nugraha, & Winursito, 2021) consider it the main asset every worker needs. Shipyard workers in Kota Batam, especially those in the production sector, are highly aware of occupational health and safety (OSH). This means that they always comply with every warning given and follow the training con-ducted concerning the OSH program.

Occupational accident and disease prevention is also invaluable. This aligns with the opinion (Barlas & Izci, 2018) that employees must be aware of the risks involved in their work. Workers at the shipyard in Batam City, especially those in the production department, are highly aware of preventing all risks of occupational accidents and diseases. That is, they are aware of the importance of occupational health and safety principles.

According to (Saifuddin et al., 2021)and (Abusitta, Bellaiche, & Dagenais, 2018), a good workplace is an important occupational health and safety prerequisite. In this regard, it was stated that shipyard workers in Batam City, especially those working in the production department, are highly aware of the importance of a good workplace to avoid all risks of disasters and diseases. That is, they are aware of the importance of occupational health and safety principles.

(Tristianto, 2018a) stated that the availability of health facilities is important to support employee health services at any time. Shelter workers in Kota Batam, especially those working on the production side, are highly aware of the availability of health facilities for them. That is, they realize, for example, that they must be covered by health insurance in every job they do.

The supervisory element in implementing occupational health and safety is also highly valued. This is in line with the opinion (Sumorek, 2017), which states that employees need to be prepared to always be under strict supervision while working. Liberal workers in Kota Batam, especially those working in the production sector, have a high awareness of the implementation of the OSH programmed supervision to ensure that they are protected from any risk of occupational accidents and diseases. That is, they are aware of the im-portance of occupational health and safety principles.

The same goes for work procedures according to SOPs. In the principles of occupational health and safety enforcement, (Tristianto, 2018b) emphasizes the importance of following all established procedures. Shipyard workers in Kota Batam, especially those working in the production division, are highly aware of the work procedures according to the SOPs to ensure that they are protected from all risks of accidents and diseases at the workplace. That is, they are aware of the importance of occupational health and safety principles

CONCLUSION

This study reveals that shipyard workers in Batam City, particularly those in the production department, demonstrate a high level of awareness regarding occupational health and safety (OHS). The findings indicate strong adherence to the use of personal protective equipment (PPE), positive attitudes in the workplace, solid knowledge of safety regulations and training, and a proactive approach to preventing workplace accidents and diseases. Workers also recognize the importance of a safe working environment, availability of health facilities, effective supervision, and strict compliance with standard operating procedures (SOPs).

These results suggest that safety culture is well established among shipyard workers in Batam, reflecting their understanding of the risks involved and the need to maintain vigilance at all times. The high average scores across all measured elements confirm that both individual behavior and organizational practices contribute positively to the implementation of OHS management systems. Therefore, it is recommended that shipbuilding companies in Batam continue to strengthen safety training, maintain consistent supervision, and encourage continuous improvement of OHS practices to achieve the goal of zero accidents and promote a sustainable, safe, and productive work environment.

CONFLICT OF INTEREST: All authors declare that they have no conflict of interest.

AUTHOR CONTRIBUTION
Conceptualization: AK, TB, AH
Methodology: AM, TB, AH
Formal Analysis: AM
Investigation: AM, TB, AH
Data Curation: AK, TB
Writing Original Draft: AK
Review and Editing: AM, TB, AH
Supervision: AK, TB, AH
Project Administration: TB, AH, S
Funding Acquisition: AK

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