

Minimizing Work Accidents in the Shipyarding Industry Using JSA and Hazop Methods

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ABSTRACT

PT. Cahaya Baru Shipyard is a company engaged in ship repair. Activities in shipyards have various risks, one of which is work accidents. The research aims to determine the risk of work accidents from shipbuilding activities, risk control and suggestions for improvement. This study identifies risks using the Job Safety Analysis (JSA) method and assisted by the Hazard And Operability Study (HAZOP) method to control potential hazards and recommendations for new safety systems to minimize work accidents. The research method used is qualitative. The results of the study show that most work accidents occur in welding and cutting activities with a percentage of 23.3%. Providing personal protective equipment and workers reminding each other to use safety equipment and to remain careful in doing their work, implementing standard operating procedures (SOPs) and existing work instructions can be a way that can be done to minimize work accidents.

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1. Introduction

Shipyard is a company engaged in the maintenance, maintenance and repair of ships. In activities at the Shipyard there are various risks that cause work accidents. Work accidents themselves occur due to several main reasons, including unsafe conditions, unsafe actions of workers (Unsafe Action), as well as human interaction and work support facilities (Rizkiana, 2017). PT. Cahaya Baru Shipyard is located in Afia village, Gunung Sitoli Utara sub-district whose main line of business is Shipyard where the production process uses several machines, iron plates, welding areas, and paint. The work carried out at the shipyard includes welding, cutting, cleaning of the ship's hull, painting, inspection of piping and installation of cables, each of which has a potential hazard to work accidents. Based on work accident data at PT. Cahaya Baru Shipyard, the occurrences of work accidents that occurred were recorded as follows, namely there were work incidents in 2019 there were 18 incidents or 32.1% of total workers, in 2020 there were 21 incidents or 37.5% of total workers and in 2020 in 2021 there were as many as 25 incidents or 44.6% of work accidents of the total workers. Many accidents occur in welding and cutting units, namely 14 or 23.3% of the total work accidents, piping inspections are 12 or 20.0% of the total work accidents and each other job is 5 incidents or 8.33% of the total incident.

Research on work accidents has been carried out by Restu Putri and Sari (2015) conducting an analysis of work accidents at a glass safety manufacturing company. In 2013, there were several work accidents experienced by employees in the production process. The analysis is carried out using the

HAZOP method which begins with identifying work accidents and then looking for potential sources of work accident hazards so that accident prevention can be done. Another study conducted by (Ruhyadi and Candra 2008) on the level of compliance with the use of PPE at PT. Almasindo II that the number of work accidents reached 16.2% or reached 17 cases out of 150 workers in the press shop and one of the reasons is because workers ignore the use of PPE. PPE provided by the company. Based on previous research, researchers in this study focused more on identifying other potential causes of work accidents at PT. Cahaya Baru shipyard and minimizing work accidents at the shipyard. Work accidents at shipyards consist of three factors, namely, environmental factors, human factors, and equipment factors. This study identifies risks with the Job Safety Analysis (JSA) method which focuses on the interaction of workers, equipment, tasks and the environment, then assisted by the Hazard And Operability Study (HAZOP) as a security arrangement to control potential hazards and minimize work accidents.

2. Literature Review

Based on the research results of Nur Ilmi Mardatilla in 2022 with the title Identification of Potential Hazards of OHS Risk Analysis with the Job Safety Analysis (JSA) Method at Panrita Lopi Pinsi in Bulukumba. The purpose of this study is to determine the potential hazards and the value of occupational health and safety (K3) risks. This type of research is quantitative with a descriptive-observational approach and a survey study. Using the Job Safety Analysis method. The results showed that in the work process 20 potential hazards were identified, while the highest risk category was priority 3 (39%) and the highest risk category was 11%.

Based on the results of research by Junatul Puandah, Sereati Hasugian in 2021 with the title Risk Analysis on Ship Activities with the HAZOP Analysis Method at KMP.Athaya. With the aim of this study aims to determine the risk of activities on board the hazop analysis method. As well as knowing the prevention that can minimize the potential danger when doing work on the ship in accordance with the applicable rules. Meanwhile, the research method used is a qualitative method. Based on the results of research and data analysis conducted by the author, it shows that there are still work safety standards that are not applied by the crew, especially in terms of the use of personal safety equipment when carrying out ship operational activities so that it has the potential to cause work accidents. The use of personal protective equipment has a major influence on the activities on board. For this reason, in order to improve the quality and fluency when working, crew members are required to comply with all regulations set on the ship and apply the use of personal protective equipment properly, in order to minimize work accidents and maximize performance on board. While this research focuses more on identifying potential hazards from interactions, equipment, tool assignments and the environment that cause work accidents so that it is at risk for workers, companies and the environment after finding hazards that cannot be controlled, efforts are made to minimize/reduce risks at a level that can be avoided. received.

Work accident

A work accident is an unexpected and unwanted event and disrupts the regulated process of an activity and can cause human victims, both human victims, or property, (Denaper 1999:4).

JSA

Job Safety Analysis is a method used to examine work methods and determine hazards that have previously been overlooked in planning a factory or building and in the design of machines, work tools, materials, work environment, and work processes. (Soeripto, 1997).

HAZOP

The Hazard and Operability Study (HAZOP) is a standard hazard analysis technique used in the preparation of a safety determination in a system or modification for a potential hazard or operability problem. HAZOP is a systematic, thorough and structured hazard identification method to identify various problems that interfere with the process and the risks contained in an equipment that can pose a

risk of harm to humans/facilities in the system. In other words, this method is used as a prevention effort so that the processes that take place in a system can run smoothly and safely (Juliana, 2008).

3. Methodology

This type of research is qualitative by identifying risks using the Job Safety Analysis (JSA) method which focuses on the interaction of workers, equipment, tasks and the environment, then assisted by the Hazard And Operability Study (HAZOP) as a security arrangement to control potential hazards and minimize work accidents.

Flowchart of Data Collection and Processing

Data collection in this study includes primary data and secondary data where primary data is data that is directly obtained in the field and from the first data source (core information) in the object/subject at the research location. The primary data referred to in this study are the results of direct interviews with company leaders and employees at work locations at PT. Cahaya Baru Shipyard. Secondary data is data in the form of records, evidence or historical reports obtained and refers to information that already exists and can be obtained from a second source (data reinforcing information). Secondary data in this study were obtained from companies and parties, employees related to this research. The research flowchart is as follows:

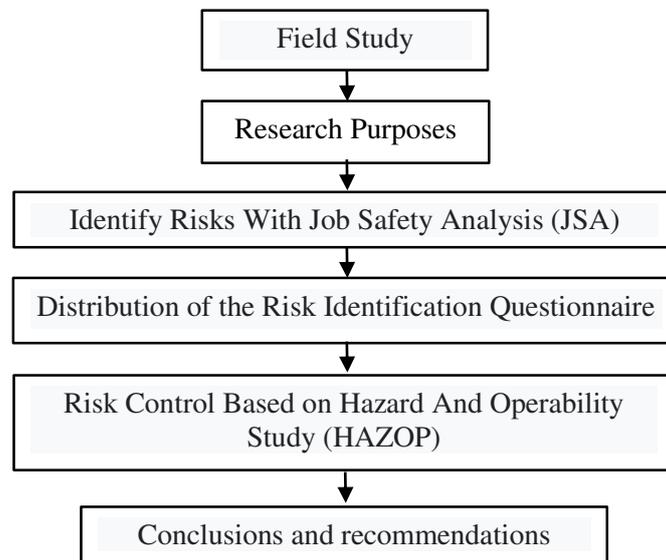


Figure 1. research flow chart

4. Results and Discussion

Data processing

Identification of hazards associated with a series of jobs or tasks, work environment and equipment is carried out using the Job Safety Analysis (JSA) method. The stages of Job Safety Analysis (JSA) are as follows:

- 1) The method of collecting data is interview and observation of the research object.
- 2) Observations and research directly in the field to obtain primary data in the form of data on conditions of work areas that are considered accident-prone and observations of personal protective equipment used by workers.
- 3) Data in the form of company documents as secondary data which is not directly observed by researchers in the form of work accident data.

The method of data processing carried out by the JSA method is as follows:

A. Choosing a Job

The following types of activities at the shipyard are:

- a. Welding and cutting
- b. Hull cleaning
- c. Painting,
- d. Piping inspection and
- e. Electricity

B. Describing the Job

Describing the work is done with the aim of sorting the work steps of work activities based on the rules that explain the steps carried out in general.

- Inspection of welds is carried out with the use and use of existing personal protective equipment. Next prepare the equipment or tools that will be used, and use diesel and lime to be smeared on the inside and outside along the weld. wait a while if the chalk is colored and dry, it means the weld is good but the weld is not good, it can be judged from the diesel fuel spots, it must be re-welded.
- Cleaning of the ship's hull is carried out by first using the available personal protective equipment, preparing the necessary equipment and then cleaning by scraping all attached plants and animals.
- Painting the ship's hull starting with wearing personal protective equipment as usual, continuing to prepare the necessary equipment, then painting with primer paint after making sure the ship is clean then painting it with the first layer of anti-fouling and painting with the second layer of anti-fouling as the last step.
- Inspection of piping aims to ensure that the pipe is maintained while distributing the processed liquid. The inspection is carried out visually by ensuring that the pipe is not leaking. The inspection begins with the use of personal protective equipment, preparing equipment and checking.
- Electrical checks always begin with the use of personal protective equipment, prepare equipment, then electrical checks on generators, cables and electric motors.

Based on work accident data at PT. Cahaya Baru Shipyard, the occurrences of work accidents that occurred were recorded as follows, namely there were work incidents in 2019 there were 18 incidents or 32.1% of total workers, in 2020 there were 21 incidents or 37.5% of total workers and in 2020 in 2021 there were as many as 25 incidents or 44.6% of work accidents of the total workers. Many accidents occur in welding and cutting units, namely 14 or 23.3% of the total work accidents, piping inspections are 12 or 20.0% of the total work accidents and each other job is 5 incidents or 8.33% of the total incident.

From the results of hazard identification using Job Safety Analysis, the following causes of work accidents are the large number of hazard equipment in shipyards if they are not proficient and trained, many shipyard workers ignore the use of PPE, lack of focus when carrying out work activities, and there is a lot of equipment that rust which causes allergies and is a hazard to shipyard workers.

Hazard and Operability Study (HAZOP)

Observation result

After finding the level of work accidents, work sequences, work risk triggers, here are the potential hazards of each work activity at PT. Cahaya Baru Shipyard.

Table 1. The potential hazards

No.	Type of activity	Potential hazard	Saverity
1.	Welding & Cutting	exposed to electric current	4
		exposed to sparks	3
		Exposure to grinding material splashes	1
		Exposed to residual hot material	2
		The room is cramped and dusty	1
2.	Hull Cleaning	Struck by falling material	3
		Noise	1
		Falling because the floor is slippery	2

		Smell of decaying organic matter	1
3.	Boat hull painting	Falling from a height	4
		exposed to sparks	3
		Falling due to slippery area	2
		Lack of oxygen	2
4.	Cable installation	exposed to sparks,	2
		Falling from a height,	4
		Lack of oxygen,	2
		Electromagnetic exposure	2
		Farthest away because the area is slippery	2
5.	Pipe inspection	exposed to electric current,	2
		Overwhelmed by the rest of the material,	3
		exposed to hot materials,	3
		Falling from a height,	4
		Holding glaswool material.	2

The severity assessment uses a hazard severity classification table which can be seen in the following table.

Table 2. The severity assessment with hazard

Description	score	Mishap Definition
<i>Catastrophic</i>	4	Death or system loss
<i>Critical</i>	3	Serious injuries that cause permanent disability Severe occupational disease Severe system crash
<i>Marginal</i>	2	Moderate wound, only requires medical treatment Minor occupational diseases Partial system failure
<i>Negligible</i>	1	Minor injuries that only need first aid Minor system damage

Based on the data obtained by using Job Safety Analysis (JSA) and assisted by the Hazard And Operability Study (HAZOP) which became the last step in this research, namely making recommendations for improvements to minimize work accidents at PT. Cahaya Baru Shipyard.

- Controlling the work system for supervision so that it is in accordance with procedures and providing danger signs so that workers know the consequences of work accidents.
- Provide counseling about the importance of using PPE because using PPE can reduce the level of risk that occurs or the injury obtained.
- Replace or repair equipment that is no longer suitable for use because it can endanger workers.
- Prohibition of entering the work area without wearing PPE
- Carry out medical examinations of workers exposed to dust to find out and monitor occupational health conditions

5. Conclusion

After doing the research, the conclusion based on the problem formulation and the results of the analysis of the JSA is summarized that the identification of hazards in shipyards using the Hazard And Operability Study (HAZOP) method found frequent (extreme) hazards identified from 5 hazard sources (welding and cutting), painting, inspection of piping and cleaning of the ship's hull and inspection of cable installations). Activities that have a high risk (extreme) occur in welding work with a percentage of 23.3% with the potential danger of being exposed to sparks, exposed to grinding material, exposed to residual hot materials and narrow and dusty rooms.

Based on research on PT. Cahaya Baru Shipyard, the suggestions that can be given by the author are that the head of the workers, the head of the office always supervise all activities at the shipyard, provide personal protective equipment and workers remind each other to wear safety equipment and

remain careful in doing so. work, application of existing standard operating procedures (SOP) and work instructions. Calculation of the RPW method on the process of re-layout after the re-layout, especially on the flow of the process of insertion, obtained the results: the cycle time is 129 minutes, 2 work stations, the efficiency of the track which was originally 18% increased to 21%, the balance delay decreased 3.1% from 3, 6% and the smoothing index fell by 327 minutes from 370 minutes.

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