



PORT MARINE SAFETY ASSESSMENT CASE STUDY ON THE INDONESIAN PORTS

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ABSTRACT

Accidents and incidents around the port's water front have the high potential to create multiplier accidents that might claim loss of life and property, especially at the busy ports. The study is aimed to assess the marine safety condition of the ports in Indonesia and to propose risk control recommendations to be implemented by the port authority, so that the safety of all activities around the port can be ensured. Type of accidents in the port area was identified, which include grounding; collision; fire; and sinking, and the causes of the accidents were investigated. Based on the findings risks assessment using Formal Safety Assessment was carried out to be used as the basis for setting the priority targets in the arrangement of safety plan and standard operating procedures. Included in the safety plan and standard operating procedures are port navigation system and facilities, quay cargo handling activities, port basin and water front condition.

Keywords: *Assessment, marine safety, port, risk, standard operating procedures*

1.0 INTRODUCTION

Marine transportation plays an important role in Indonesia's geo-politics and geo-economics for ensuring the connectivity between its more than 17,000 islands to carry cargo as well as people, so that efficiency and effectiveness of reciprocal trading and movement of people from one place to the others can be increased. Beside ships other important aspect of marine transport is the port performance, which includes the activities of cargo handlings and the safety of vessels traffic around port area. There were many accidents occurred in the port entrance channels and port basins that disturbed and threatened the smoothness of vessels entering or leaving the port, and in some cases would cause other accidents [1]. Based on the data recorded by National Transportation Safety Committee (KNKT) there were at least 10 accidents happened in the port entrance channels and port basins [2]. The study is aimed to assess the safety condition of the main ports water front area in Indonesia and to propose risk control recommendations the port authority, as part for improving the port performance.

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2.0 RESEARCH QUESTION

As the guideline for focusing the research on the set objectives the research questions were risen as:

1. How is the safety condition of the port navigation lanes and basins of main ports in Indonesia and their effects to the work performance of the ports?
2. How the strategy should be arranged to improve the safety condition of port navigation lanes and basin of Indonesia's main ports as an effort to increase the smoothness of ships calling at the ports.

3.0 METHODOLOGY

The study was initiated by gathering data and information related to the accidents occurred around port water front area and their effects to the operation of vessels in the area through literature surveys, field investigations, and interviews with stakeholders. Rules and regulations related to port safety were then reviewed as the basis for assessing the existing safety condition; results of the assessment were then used for arranging the proposed standard operating procedures.

3.1 Accidents in The Port Water Front Area

According to the data published by National Transportation Safety Committee from 2009 to 2016 there were 34 significant ships accidents occurred in Indonesia waters and around 10 of them happened in the port water front areas? According to KNKT the types and percentage of the accidents in general were identified as 35% due to explosion and fire; 31% due to collision; 24% due to sinking; 4% due to grounding, and 4% due to others causes, as shown on figure 1. But for those accidents occurred in the port water front area consecutively were: collision, grounding, sinking, fire, and others [3]

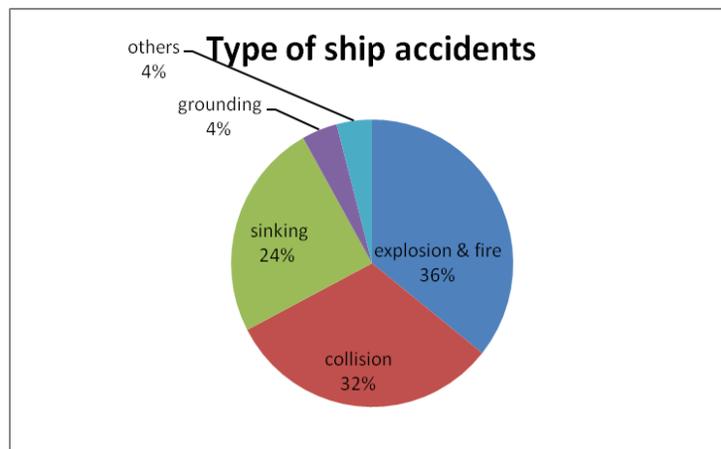


Figure 1. Composition of ship accident types (source KNKT)

3.2 Risk Assessment

In order to obtain appropriate information concerning the safety condition of the navigation lanes and basin of main ports in Indonesia a risk assessment was carried out using International Maritime Organization's Formal Safety Assessment method [4], as a rational and systematic process for assessing the risks relating to maritime safety and the protection of the marine environment. The assessment consists of five steps which include hazards identification, risk analysis, risk control options, cost benefit assessment, and recommendations for decision making.

3.2.1 Hazard identification

Hazard is defined as something which can lead to an undesired outcome in the process of meeting an objective. This can involve injury to human beings, damage to property, or harm to the environment, or a combination of some or all of these three [5]. Hazard identification is the process of finding, listing, and characterizing hazards. Hazards of the potential accidents that had been identified based on the recorded data are presented in table 1.

Table 1: Hazards of potential accidents

Potential Accident	Identified Hazard
Collision	<ul style="list-style-type: none"> - Navigation failure - Bad weather - Traffic congestion - Communication failure
Grounding	<ul style="list-style-type: none"> - Navigation failure - Bad weather - Environment obstacles - Bad infrastructure
Sinking	<ul style="list-style-type: none"> - Bad ship condition - Improper cargo arrangement - Bad weather - Environment obstacles
Fire	<ul style="list-style-type: none"> - Bad ship system - Operational failure - People ignorance - Improper safety management
Others	<ul style="list-style-type: none"> - Bad ship condition - Improper cargo arrangement - Operational failure

3.2.2 Risk analysis

Risk analysis is a process for comprehending the nature of hazards and determining the level of risk. Risk analysis provides a basis for risk evaluation and decisions about risk control.

Risk is defined as potential losses and rewards resulting from an exposure to a hazard or as a result of risk event [6]. Risk analysis involves event probability and event consequence as shown in formula 1.

$$R = P \times C \quad (1)$$

Where R is risk level; P is probability; and C is consequence.

Risks are categorized as: intolerable, tolerable, and acceptable [7] as shown in table 2. Intolerable risks are risks which have high level of consequences that might cause death or fatal injury to people, create catastrophe, total damage to property, and major financial loss, and high probability of their occurrences. Tolerable risks are the risks that people are generally prepared to tolerate due to their high benefits or unavoided situations, and their occurrence is not very often. The risks might create inconveniences, minor injury to people, and minor damage to property or minor financial loss. Acceptable risks are risks that people would regard as insignificant and do not need any mitigation if they exist. They might create minor inconveniences but no injuries, or very low financial loss.

Probability is categorized as: frequent, likely, occasionally, seldom, and unlikely as shown in table 3. Frequent when the accident occurs more than once per year, likely when accident occurs

less than once per year, occasionally when accident occurs once in three years, seldom when accident occurs once in five years, and unlikely when accident occurs once or less in ten years.

Consequence is categorized as: major, moderate, and minor as shown in table 4. Major when the accident might cause death or fatal injury to human or total damage to the ship system and/or structure. Moderate when accident might cause injury to human and/or damage to ship and/or structure. Minor when accident might cause minor injury to human or minor damage to ship or structure.

Table 2. Risk level

Risk level	Risk category
16 to 25	Intolerable
6 to 15	Tolerable
Under 5	Acceptable

Table 3. Accident occurrence probability

Description	Scale	Occurrence
Frequent	5	More than once per year
Likely	4	Less than once in per year
Occasionally	3	Once in 3 years
Seldom	2	Once in 5 years
Unlikely	1	Once or less in 10 years

Table 4. Accident consequence/severity

Description	Level	Severity
Major	5	Might cause death or fatal injury to human and Total damage to the ship system/structure
Moderate	3	Injury to human and damage to ship system or structure
Minor	1	Minor injury to human or minor damage to ship

Risk analysis is conducted based on the risk level obtained from the conversion of qualitative measure of occurrence probability and its consequence to quantitative measure and presented in the form of risk matrix as shown in table 5.

Table 5. Risk matrix

PROBABILITY	CONSEQUENCE/ SEVERITY		
	Major (5)	Moderate (3)	Minor (1)
Frequent (5)	Intolerable	Tolerable	Acceptable
Likely (4)	Intolerable	Tolerable	Acceptable
Occasionally (3)	Tolerable	Tolerable	Acceptable
Seldom (2)	Tolerable	Tolerable	Acceptable
Unlikely (1)	Acceptable	Acceptable	Acceptable

3.2.3 Risk control options

Refer to the results of risk analysis some option for controlling the risks should be proposed, intolerable risk must be eliminated or reduced so that it falls into one of the other two categories, or there must be exceptional reasons for the activity or practice to continue. Tolerable risks must be properly assessed and controlled to keep the residual risk at acceptable level of safety, and must be reviewed periodically to ensure they remain that way.

3.2.4 Cost benefit assessment

In order to take priority on the most applicable risk control cost benefit assessment was carried out on the risk control options obtained previously based on the results from risk analysis. The assessment was conducted by listing and comparing the costs and benefits of each risk control option, the highest benefit of the options are taken as recommendation for decision making.

3.2.5 Recommendation for decision making

The selected risk control options from cost benefit assessment were proposed to the authority or decision makers as recommendation for arranging standard operating procedures to eliminate or minimizing accidents in port water front area.

4.0 ASSESSMENT RESULTS

Based on the risk analysis of the recorded accident data the rank of risk level of each recorded accident from the highest are shown in table 6. The risk control options are shown in table 7. Based on cost benefit assessment since there are not much recommendation given to the ships management, the priority of risk control are recommended mainly to the port authority, which include: recruit qualified human resources, compliance to rules and regulations, conduct regular safety drilling, regular main tenance of navigation facilities, deploy qualified piloting crews, and deploy competent rescue team.

Table 6. Risk level of recorded accidents

Recorded Accident	Risk level
Grounding	Intolerable (20)
Fire	Intolerable (20)
Sinking	Tolerable (9)
Collision	Tolerable (9)
Others	Tolerable (6)

Table 7. Risk control options

Source of risk	Control option
Human factor	<ul style="list-style-type: none"> - Recruiting qualified work force - Conduct regular safety drillings - Attend appropriate trainings regularly - Demonstrate safety procedures - Comply to the rules and regulations
Weather	<ul style="list-style-type: none"> - Monitor the weather broadcast
Environment	<ul style="list-style-type: none"> - Monitor the environment condition - Regular maintenance of channel and basin depth
Infrastructure	<ul style="list-style-type: none"> - Regular maintenance of port infrastructure - Regular maintenance of navigation facilities - Procure rescue facilities
Ship	<ul style="list-style-type: none"> - Comply to the rules and regulations - Regular maintenance of navigation equipment - Implement ship management system - Provide appropriate safety appliances
Authority	<ul style="list-style-type: none"> - Strict enforcement of laws and regulations - Provide appropriate navigation system - Implement routine facilities maintenance system - Deploy competent rescue team

5.0 CONCLUSIONS

The risk level rank of identified potential accidents is: intolerable for grounding and fire, tolerable for sinking, collision and others. Risk control options are mainly proposed recommended to port authority which includes: recruit qualified human resources, compliance to rules and regulations, conduct regular safety drilling, regular maintenance of navigation facilities, deploy qualified piloting crews, and deploy competent rescue team.

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