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THE DANGEROUS GOODS LOADING-UNLOADING ACTIVITIES IN THE PORT OF TANJUNG PRIOK INDONESIA

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ABSTRACT

This study aims to analyze the safety conditions of ship operations in loading and unloading dangerous goods by the main port of Tanjung Priok, in northern Jakarta, Indonesia. The main purpose of this research is to provide input to improve the safety requirement of ship operations in loading and unloading dangerous goods by the Main Harbormaster. Data analysis was completed using the Analytical Hierarchy Process by involving related parties of shipping safety. Respondents consisted of the main port as the supervisor and permit giver, the port management as the port facilitator, the loading and unloading company as the executor in the field, and the goods owner as the consumer. The results showed that the main factors affecting safety in loading and unloading of dangerous goods at Tanjung Priok port were supporting facilities and infrastructure at the port. In addition, the readiness of human resources is also a determining factor. In conclusion, this study recommend that the Tanjung Priok Port Main Harbormaster needs to be more disciplined in enforcing rules in the field, especially when inspecting dangerous goods loading and unloading activities at the port so that the safety of port operations can be insured.

KEYWORDS: *Loading and Unloading, Dangerous Goods, Operational Safety, Ports, Main Harbormaster*

INTRODUCTION

There are hundreds of loading and unloading activities at the busy ports everyday. One of the goods loaded or unloaded from and or onto the ship is dangerous goods or commonly called as dangerous cargo. In the Decree of the Minister of Transportation of the Republic of Indonesia 2000 concerning guidelines for handling dangerous goods in shipping activities, it is stated that dangerous goods or hazardous materials are materials that are categorized as harmful to living things, namely humans, animals, plants and the environment. This causes the material to require special handling in the shipping process. Handling of dangerous goods also refers to the international rules, namely the International Maritime Dangerous Goods Code (IMDG Code) which is an international code used by shipping carriers and also all parties related to the shipping world. The IMDG Code includes regulations and explanations regarding details of cargo, packaging, labeling, placarding, marking, stowage, segregation, handling, and emergency response. Meanwhile, goods that are included in the dangerous category are explosives, gases, poisons, radioactivity, corrosives, waste, and others (International Maritime Organization (IMO, 2006). According to (Popek & Bogalecka, 2007) IMO and the Government must have the possibility in order to establish permanent regulations to ensure safe transportation of Dangerous Goods, one must be able to implement regulations regarding the transportation of Dangerous Goods which is highly dependent on an appreciation by all those with an interest in the risks involved and understanding of regulatory details.The model already implemented for Master Bay Planning by addressing containers that hold dangerous goods are referred to as IMO containers (Kebedow

& Oppen, 2018). Incompatible IMO containers must be separated from each other on board the ship according to special rules.

Several investigations regarding loading and unloading activities at the port, or commonly known as stevedoring, have been studied before. According to (Ramadhani et al., 2020) the efficiency of the loading and unloading process at the port can minimize the ship's cost budget. At the Gresik public port, several methods are needed such as the quality function deployment method, the Importance Performance Analysis (IPA) method which has been used to determine service perceptions and determine priorities for handling improvements in loading and unloading speed and productivity at Gresik Public Port (Widodo & Suprayitno, 2020). Meanwhile, the finding at The Tanjung Emas Port, Semarang, based on the study by (Permata et al., 2019) showed that partially the weight of the container had a significant negative effect on loading and unloading productivity, and the number of aisles had a significant positive effect on loading and unloading productivity. Finally, the study by (Aldaghlas et al., 2021) in Australia confirmed that the initiation of stevedoring activities is still a challenge for several organizations, i.e. related to lack of trust in the workplace, high individualism, ineffective inter-departmental communication, lack of resources and complexity of engineering and safety.

In general, the transportation of Dangerous Goods in the port and shipping industry in China has recorded many types of container terminal accidents (Jianzhe et al., 2020). China has revised the Dangerous Goods safety management for bulk liquid at ports, in particular the safety management of ship operations at ports and terminal operations safety management (C. Ruan et al., 2020). Previous research has proven that Formal Safety Assessment (FSA) is a fairly effective method to strengthen the management of containers carrying Dangerous Goods and prevent accidents, and has an important role in reducing accidents. In addition, the SFA method allows appropriate action to be taken in dealing with accidents on time (Ma, 2013). Factors that affect the less than optimal loading of Container Dangerous Goods, among others, are caused by limited equipment and crew, related to the preparation of goods for transportation, packaging, container filling, and loading onto ships. This is a major factor contributing to the release of dangerous goods on board (Ellis, 2011; Nugroho, 2020).

Based on a study (Haryanto et al., 2020) at the Port of Tanjung Perak, Surabaya, it was found that the Standard Operating Procedure was not optimal, so the task of supervising Dangerous Goods had not been carried out properly. In addition, the existing facilities and infrastructure at the port are also indicated to be inadequate. This condition can reduce the port's ability to carry out supervision. The limited number of personnel also causes services under the supervision of Dangerous Goods to be less than optimal. Another study related to the process of handling vehicles loaded with Dangerous Goods at Merak Port, Ketapang Port and Bajoe Port in Indonesia, found that Ketapang Port and Merak Port had procedures for handling Dangerous Goods which were developed based on technical guidance from PT. ASDP Indonesia Ferry (Noor, 2017). However, there are still many violations committed by officers in the field so far, because the limited facilities owned make it difficult to carry out the procedures that have been set. Based on these conditions, it is important to carry out better handling of Dangerous Goods cargo in loading and unloading activities at ports or even in waters so that stricter supervision is needed so that accidents do not occur that can threaten shipping safety.

Supervision related to the handling of Dangerous Goods in shipping activities in Indonesia including the loading and unloading of Dangerous Goods has been stipulated in the amendment to the Decree of the Minister of Transportation of 2010 which mandates the Director General of Sea Transportation as a competent authority in implementing international regulations regarding the transportation of Dangerous Goods by sea (IMDG Code 2008) in Indonesian waters. Thus, the Main harbormaster is the party involved in the port to carry out direct supervision regarding the handling of Dangerous Goods, including the process of loading and unloading activities at the Tanjung Priok Port, Jakarta.

Based on this background, research is needed on the safety of ship operations in loading and unloading Dangerous Goods by the Main Port of Tanjung Priok Harbor in North Jakarta.

LITERATURE REVIEW

Loading and Unloading Activities

Loading and unloading activities are the peak of port business activities for shiploads. Ship service is an activity to facilitate activities to unload and or load goods from and or to the ship's top (Lasse, 2014). Based on the Regulation of the Minister of Transportation Number 152 of 2016 concerning the Organization and Concession of Loading and Unloading of Goods From and To Ships, loading and unloading includes stevedoring, cargodoring, and receiving/delivery activities. The loading and unloading business activities of goods can be carried out by the operator of loading and unloading activities consisting of: (1) Loading and Unloading Company, (2) National sea transportation company; and (3) port business entities that have obtained concessions. Loading and unloading activities at the port (stevedoring), require serious attention to safety, safety motivation and safety performance which are significantly mediated by safety management supervision (Shang et al., 2011). The impact on employees and users of loading and unloading services, work arrangements and their implications for container loading and unloading workplace performance also needs to be considered (Productivity Commission, 2002). Port field is one of the most dangerous jobs in the industry sector. It includes manual work in tricky accessible workplaces as well as deep interaction with heavy machinery, hazardous cargoes and dense traffic and movement. Technical developments, for example in the cargo handling equipment, have to a great extent enhanced the safety of port workers (Hinkka et al., 2016). According to the experts, safety issue mostly arises when loading and unloading process of the cargo take place. This because some of the dry bulk cargoes can be hazardous or very sensitive materials. Hence, a strict measure and appraisal to the changes of conditions of the ship and the port environment need to be applied (Othman et al., 2019). The port activity is marked by diversity depending on the type of cargo to be transported, resulting in distinctive inserts in the composition of the workforce needed for its execution. The work of stowage occurs exclusively on the deck and in the ship's holds. This involves loading and unloading of cargo, these conferences, storage in the basement, repair charges within the vessels run the following categories: stevedores (dressed up and remove the goods on deck and in the holds of ships) (Kaminski et al., 2015). Faults that occurred during activities such as preparation of the goods for transport, packaging, stuffing containers, and loading the ship were main factors contributing to the release of the dangerous goods on board the ship (Ellis, 2011)

Aspects of Responsibility, Cost Risk, and Safety of Goods

Based on the legal relationship between ship operators (shipping) and loading and unloading companies, loading and unloading activities are (1) stevedoring; (2) cargodoring; and (3) receiving; and (d) delivery (Lasse, 2014; Sasono, 2012). The stevedoring activity in the liner service system is an extension of the responsibility of the shipping company, meaning that the loading and unloading of goods from and or onto the ship is carried out by the shipping company. While outside the loading and unloading liner system, it is carried out by a special agency called the Unloading Company.

Loading and unloading activities or stevedoring are unloading goods and/or raising goods from or onto the ship. For unloaded goods, goods are transferred onto trucks or train cars, or onto barges; or to the warehouse/field, namely an activity called cargodoring, while receiving is an activity to receive goods that are unloaded from the ship. Receiving can take place on the ship side directly to the truck or to the barge, and on the land side warehouse/field for goods through the warehouse/field to be received to the consignee or representative. Delivery is the delivery of goods by the ship (carrier) to the recipient (Lasse, 2014).

Dangerous Goods

Dangerous goods management by reducing risk factors to a minimum is a very realistic option, because the transportation of dangerous goods is a risky procedure (Batarliene & Jarašuniene, 2014). Transportation technology is very much needed in the delivery of Dangerous Goods which is one of the most complex security, so because of the risk, it must be handled appropriately. According to (Šolc & Hovanec., 2015), special attention is needed on the transportation of Dangerous Goods, which can have risky consequences that harm humans, as well as the environment. Handling of Dangerous Goods in China must apply professional management based on experience for the safety of its transportation (Shu-yun et al., 2016). It is added, according to (Hoskova-Mayerova & Becherova, 2016), that the specific area of material transportation requires more emphasis on prevention and transportation safety, so that a properly secured load will increase the safety of the surroundings.

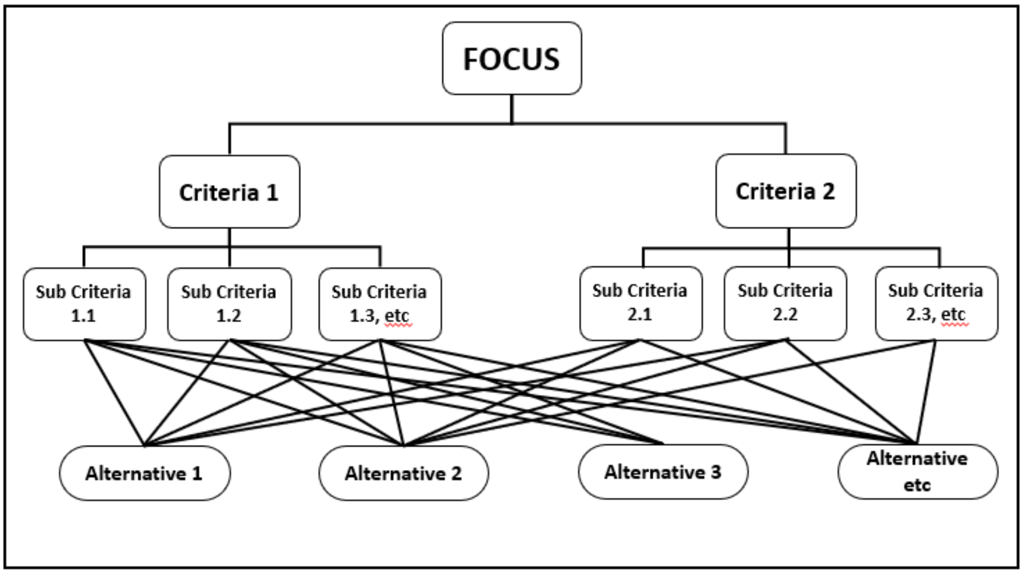
The activities of unloading ship cargo take place in the order of ship operations, quay transfer operations, storage operations, and receiving and delivery (Lasse, 2014). Regulation of the Minister of Transportation No. KM 17 of 2000 concerning Guidelines for Handling Dangerous Goods in Shipping Activities in Indonesia states the application of the International Maritime Dangerous Goods (IMDG) Code along with its supplements as guidelines for handling dangerous substances / goods in shipping activities in Indonesia. Based on these regulations, the classification of hazardous cargo types is as follows: Explosives; compressed, liquefied or dissolved gas material with pressure; flammable liquids; flammable solids; substances liable to spontaneous combustion; and other substances, when in contact with water, emit flammable gases.

To handle dangerous goods in loading and unloading activities at port, the one must get permission from the relevant port operator. The implementation of the activities must obtain permission from the harbomaster to get special handling (Supit, 2009). The instructions that must be considered in carrying out the loading and unloading of Dangerous Goods to and from ships at the port are as follows: (1) first make sure the loading and unloading equipment will be used in conditions that meet the requirements, and also make sure the packaging is strong; (2) prepare fire hose and CO2 installation; (3) participate in giving direction to PBM in terms of loading / unloading security and placement of goods; and (4) Dangerous Goods may not be put together with other cargo and it is recommended to be loaded on-deck. Incorrectly declared dangerous goods is also identified as a contributing factor for the fatal accidents. Ensuring that dangerous goods are correctly prepared and documented for marine transport is thus very important for preventing releases and improving on board safety (Ellis, 2011).

METHODS

This research uses a qualitative approach with a case study design. The data analysis method used is the Analytical Hierarchy Process (AHP). The AHP method is a flexible hierarchical analysis model that allows for analysis and decision making by combining personal considerations and values logically (Bourgeois, 2005). AHP is also a representation of a complex problem in a multi-level structure where it starts with a goal, followed by the level of factors, criteria, sub-criteria, and so on until the last level alternative (Saaty, 1993). AHP according to (Saaty, 2001) is used to derive the ratio scale from several continuous pairwise comparisons. Pairwise comparisons can be obtained through actual measurements or relative measurements of the degree of liking, or interests or feelings. AHP is a flexible model that allows analysis and decision making by combining personal considerations and values logically, can set a new scale to measure the properties that have occurred (Kusrini, 2007).

Several stages of the AHP method with detailed decision making are (Saaty, 2001); (1) Define the problem and determine the desired solution, (2) Create a hierarchical structure that begins with a general goal, (3) Form a pairwise comparison matrix, (4) Normalize the data by dividing each value of each element in the paired matrix, (5) Calculating the eign vector value and testing its consistency, (6) Repeating steps 3, 4, and 5 for all levels of the hierarchy, (7) Calculating the eign vector value from each pairwise comparison matrix and 8, Testing the consistency of the hierarchy. Hierarchy level I is the focus which is the overall goal of this system, for level II is as a criterion, while for level III is a sub-criteria of level II criteria, while level IV is alternatives that are selected based on predetermined criteria and sub-criteria (Picture 1). The research informants were: one employee of the Tanjung Kesok Port Main Kesyahbandaran; one Port of Tanjung Priok Port Management employee; one owner of goods and one labor loading and unloading. Data collection methods used are observation, interviews and documentation. AHP on transportation modes was previously studied by (Handayani et al., 2019). The use of the AHP method has been used in container loading and unloading activities at the port to improve the performance of the container terminal (Ha et al., 2017; Hervás-Peralta et al., 2019).



Source: (Saaty, 1998)

Figure 1: AHP Hierarchy Level.

RESULTS

Research Findings

When the loading and unloading company has obtained a permit from the Tanjung Priok Main harbor, but in the field implementation, there may be still a misunderstanding which led to the temporary suspension of the loading and unloading process. Errors occur when field officers as supervisors do not master the knowledge about the placement of dangerous goods (stowage) which has been regulated in the IMDG Code. Knowledge of the IMDG Code needs to be possessed by KPLP officers including porters, especially in matters relating to packaging, marking, labeling, and stowage requirements. Currently, the Tanjung Priok port only provides services in the form of facilities and infrastructure needed such as technical tools and loading and unloading mechanics as well as a stacking yard or warehouse for storing goods.

From several research findings at Tanjung Priok Port, Jakarta, the data analysis step taken to determine the priority scale from various sources of a problem is the AHP method. The criteria specified in the processing of AHP method are as follows: (1) Technical coordination with Internal Focus Group Discussion (FGD) activities, (2) Inspection of permits and seaworthiness, (3) Routine surveillance and patrols and (4) supporting infrastructure facilities. Meanwhile, the informants involved are: (1) Port of Tanjung Priok Port, (2) Management of Tanjung Priok Port, (3) Loading and Unloading Company, and (4) Goods Owner.

Before determining the priority weight for each research criterion, the importance level value is set as in Table 1.

Table 1: The Importance Level Value of AHP

Level of Importance	Value A	Value B
A and B are equally important	1,0000	1,0000
A Slightly more important than B	3,0000	0,3333
A is Stronger in Importance than B	5,0000	0,2000
A Very Strong in importance than B	7,0000	0,1429
A is Absolutely More Important than B	9,0000	0,1111
Intermediate Value	2,4,6,8	1/2, 1/4, 1/6, 1/8

Data Analysis

Pairwase Comparison Matrix

Pairwase Comparison Matrix is a way to determine the weight value of a criterion in the AHP method. The pairwise comparison matrix works by comparing one criterion with another by means of a weighted value. The result of the pairwise comparison matrix of criteria in decimal is exhibited (Table 2).

Table 2: Matrix of Paired Comparison Criteria in Decimal

Criteria	FGD	Permit Inspection and Seaworthiness	Surveillance & Patrol	Facilities and Infrastructure	Eigen Value	Weight of Priority
FGD	1,0000	0,2000	3,0000	0,1429	0,5411	0,0945
Permit inspection and seaworthiness	5,0000	1,0000	7,0000	3,0000	3,2011	0,5593
Surveillance & Patrol	0,3333	0,1429	1,0000	0,3333	0,3549	0,0620
Facilities and Infrastructure	7,0000	0,3333	3,0000	1,0000	1,6266	0,2842

In determining the weight value in the pairwise comparison matrix with the criteria in decimal, the researcher uses assumptions based on references and literature studies from various sources. Furthermore, after the value is determined for each, the matrix value is calculated from the eigenvalues. Eigen value is obtained by multiplying each row of the comparison matrix of each criterion then raised to the power of 1/n where the value of n is the number of criteria used in the study, namely four criteria.

Synthesis Weighting and Maximum Eigen Value

The next action is to normalize the pairwise comparison matrix table of criteria in the study, as shown (Table 3).

Table 3: The Normalization of Criteria Weighting Table

FGD	Permit Inspection and Seaworthiness	Surveillance & Patrol	Facilities and Infrastructure	Synthesis Weight	Eigen Maks (X)
0,0750	0,1193	0,2143	0,0319	0,4405	4,6599
0,3750	0,5966	0,5000	0,6702	2,1418	3,8296
0,0250	0,0852	0,0714	0,0745	0,2561	4,1301
0,5250	0,1989	0,2143	0,2234	1,1616	4,0873
Total					16,7070

The normalization value in table 3 is obtained from the results of dividing the weight value of the criteria by the total number of criteria comparison matrix tables. The next step is calculating the value of the synthesis weight obtained by adding up each row of criteria. While the maximum eigenvalues are obtained by dividing the value of the synthesis weights in Table 3 with the priority weights in Table 2 of the criteria paired comparison matrix. So that the maximum number of eigenvalues is 16.7070.

Finding the Maximum Lambda Value, Index Consistency, and Ratio Consistency

To find the maximum lamda value, the maximum number of eigenvalues is divided by the number of criteria used (Bourgeois, 2005). In checking the inconsistency of opinions or weighting assumptions, if the CR value is less than 10%, it is considered acceptable. In this study, the value of the consistency ratio is 0.0655, so the opinion or assumption of the weighting of the criteria is still acceptable or the research is worth continuing for the weighting of alternative data from research informants based on research criteria.

Alternative Data Weighting based on Criteria

After weighting the criteria data, the next step is to weight the data between alternatives or informant data based on the research criteria. Informant data was obtained from survey results and field interviews. The informants include the port management, loading and unloading companies operating at Tanjung Priok port, and goods owners as port consumers. The following are the results of the weighting of the informant's data based on the research criteria.

Table 4: Alternative Weighting of Tanjung Priok Main Harbormaster Informants

Informant 1	Main Harbormaster				0.2000	
Criteria	**FGD**	**Permit inspection and Seaworthiness**	**Surveillance & Patrol**	**Facility and Infrastructur**	**Eigen Value**	**Weight of Priority**
FGD	1,0000	0,1429	0,2000	0,1429	0,3328	0,0616
Permit inspection and seaworthiness	7,0000	1,0000	3,0000	9,0000	2,8529	0,5280
Surveillance & Patrol	5,0000	0,3333	1,0000	5,0000	1,5281	0,2828
Facility and Infrastructur	7,0000	0,1111	0,2000	1,0000	0,6893	0,1276
Total	20,0000	1,5873	4,4000	15,1429	5,4031	1,0000

Table 5: Informants' Alternative Weighting of Tanjung Priok Main Harbormaster

Informant 2	Port Management				0.2000	
Kriteria	**FGD**	**Permit Inspection and Seaworthiness**	**Surveillance & Patrol**	**Facility and Infrastructur**	**Eigen Value**	**Weight of priority**
FGD	1,0000	0,3333	3,0000	0,2000	0,7248	0,1538
Permit inspectio and seaworthiness	3,0000	1,0000	5,0000	0,3333	1,3797	0,2928
Surveillance & Patrol	0,3333	0,2000	1,0000	0,3333	0,4670	0,0991
Facility and Infrastructur	5,0000	3,0000	3,0000	1,0000	2,1411	0,4543
Total	9,3333	4,5333	12,0000	1,8667	4,7127	1,0000

Table 6: Weghting Alternatives from Informant Loading Company 1

Informant 3	Loading company 1				0,2000	
Criteria	**FGD**	**Permit Inspection and Seaworthiness**	**Surveillance & Patrol**	**Facility and Infrastructur**	**Eigen Value**	**Weight of priority**
FGD	1,0000	3,0000	5,0000	0,2000	1,2457	0,2502
Permit inspection and seaworthiness	0,3333	1,0000	3,0000	0,3333	0,8027	0,1612
Surveillance & Patrol	0,2000	0,3333	1,0000	0,1429	0,3942	0,0792

Table 7 Weghting Alternatives from Informant Loading Company 2

Informant 4	*Loading Company 2*				0,2000	
Criteria	**FGD**	**Permit Inspection and Seaworthiness**	**Surveillance & Patrol**	**Facility and Infrastructur**	**Eigen Value**	**Weight of Priority**
FGD	1,0000	5,0000	3,0000	0,1429	1,1647	0,2463
Permit inspection and seaworthiness	0,2000	1,0000	3,0000	0,3333	0,7248	0,1533
Surveillance & Patrol	0,3333	0,3333	1,0000	0,2000	0,4670	0,0988
Facility and Infrastructur	5,0000	3,0000	5,0000	1,0000	2,3714	0,5016
Total	6,5333	9,3333	12,0000	1,6762	4,7279	1,0000

After all the weighting data from the Informants are collected and summed, the next step is to recalculate the pairwise matrix between the criteria of each alternative weighting of each Informant, as shown (Table 8).

Table 8: Final Weghting Alternatives

Criteria	FGD	Permit Inspection and Seaworthiness	Surveillance & Patrol	Facility and Infrastructur	Eigen Value	Weight of Priority
FGD	1,0000	1,2099	2,2795	0,1039	1,1464	0,0089
Permit inspection and seaworthiness	0,8265	1,0000	4,4860	1,0000	14,8312	0,1146
Surveillance & Patrol	0,4387	0,2229	1,0000	0,3124	0,1222	0,0009
Facility and Infrastructur	8,8466	1,0000	3,2011	1,0000	113,2749	0,8756
Total	11,1118	3,4328	10,9666	2,4163	129,3747	1,0000

Matrix Value in Final Priority Scale

The matrix value or final priority scale is a calculation obtained from the weighting data between criteria with alternative data weighting data (Informants) based on criteria. Table 9 shows the final score data from the weighting of the criteria obtained from Table 2, and Table 8 is the final value data from the weighting of the informant data from each criterion obtained through the survey and interview stages.

Table 9: Final Value of Weight Priority of Research Data Criteria

Criteria	Weight of Priority
FGD	0,0089
Permit inspection and seaworthiness	0,1146
Surveillance & Patrol	0,0009
Facility and Infrastructur	0,8756

Table 10: Final Value of Data Weighting Matrix between Alternatives

Informant	FGD	Permit inspection and seaworthiness	Surveillance & Patrol	Facility and Infrastructur	Matrix Value
Main Harbomaster	0,0616	0,5280	0,2828	0,1276	0,3549
Port Management	0,1538	0,2928	0,0991	0,4543	0,3135
Loading Company 1	0,2502	0,1612	0,0792	0,5094	0,2635
Loading Company 2	0,2463	0,1533	0,0988	0,5016	0,2577
Goods Owner/ consumer	0,2391	0,2832	0,1062	0,3716	0,2932

DISCUSSIONS

The results obtained from the AHP calculation and analysis show the matrix and ranking values as shown in Tabel 11.

Table 11: Final Priority Ranking

Informant	Matrix Value	Ranking
Main Harbomaster	0,3549	1
Port Management	0,3135	2
Loading company 1	0,2635	4
Loading company 2	0,2577	5
Goods owner	0,2932	3

Based on the Tabel 11, the Main Harbomaster is the most important and most influential party in the efforts to improve the safety of Dangerous Goods loading and unloading activities at the Tanjung Priok port in Jakarta with a score of 0.3549. The next ranking is the Port Management with a score of 0.3135, goods owner with a score of 0.2932, and loading companies 1 & 2 with a score of 0.2635 & 0.2577.

In addition, AHP calculation and analysis also obtained priority weights and rankings as shown in Tabel 12.

Table 12: Priority Ranking Criteria

Criteria	Priority Weight	Ranking
FGD	0,0089	3
Permit and Seaworthiness	0,1146	2
Surveillance & Patrol	0,0009	4
Facilities & Infrastructure	0,8756	1

Table 12 shows the priority scale for each criterion for which is the most influential in the efforts to improve safety for Dangerous Goods loading and unloading activities at the Tanjung Priok port. The most influential criteria are successively: facilities and infrastructure with the final value of (0.8756), licensing and seaworthiness with the final value of (0.1146), technical coordination activities with FGD with the final value of (0.0089), and supervision & patrol in the field with the final value of (0.0009).

This research is in line with research (Li, 2017), which explains that for mobility and high risk of port workers, dynamic monitoring and management of workers on site cannot be carried out with existing technology. In order to ensure the safety of land workers in hazardous port operation areas, a new port land worker safety monitoring and warning system is based on RFID, internet and intelligent alarm technology. This study also supports research by (J. Ruan, 2016), in China that a dangerous ship accident rescue system can increase the effectiveness of dangerous goods ship accident rescue. Another study by (Yingjun et al., 2010) also agrees with the results of this study, they explain that it is very important to improve the safety of transportation of dangerous goods with containers with a dangerous goods condition monitoring system based on a wireless sensor network. This study also supports the results of research (Xie et al., 2021), which shows that the main risk factors are the inherent hazardous characteristics of dangerous goods, improper storage methods, substandard packaging, and failure to carry out the main responsibilities of port operators. , weak worker safety awareness and inadequate safety oversight. As a good lesson in China, there are currently standards regarding the handling, storage and storage of dangerous goods containers in port areas, in particular the short-term storage and segregation of different dangerous goods containers (Lu et al., 2019). Thus, it can be concluded that with this research, the handling of dangerous goods at each port can apply several loading and unloading standards at the container terminal.

CONCLUSIONS

The most influencing factor in the effort of improving safety in the loading and unloading activities of Dangerous Goods at the Tanjung Priok port is the supporting facilities and infrastructure at the port with the AHP score of 0.8756. While the most influential party in these activities is the Main Harbormaster Port of Tanjung Priok with an AHP score of 0.3549. To realize maximum shipping safety, the main port of Tanjung Priok Port needs to be more disciplined in enforcing rules in the field, especially when inspecting Dangerous Goods loading and unloading activities.

The increased safety of shipping at Tanjung Priok Port will directly impact the integrity of the national port so that investors and national logistics suppliers can perform their roles well. The findings of this study should be implemented properly so that it can have an impact on the efficiency and dwelling time of the Tanjung Priok port. This can also provide a solution to the process of loading and unloading activities that are still constrained so that it can cause material losses and even accidents while working and shipping.

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