Indonesian Journal of Administration and Health Research
e-ISSN 3089-1051 / P-ISSN 3090-1073
Vol. 1, No. 2, December 2024, Pages 73-80
https://ejournal.itekesmukalbar.ac.id/index.php/ijahr

RESEARCH OPEN ACCESS

Risk Analysis of Work Accidents in the Loading and Unloading Process Using Job Safety Analysis (JSA) and Hazard and Operability Study (HAZOPS) Methods at PT Pelindo II (Persero) Branch Pontianak

Analisis Risiko Kecelakaan Kerja pada Proses Bongkar Muat Menggunakan Metode Analisis Keselamatan Kerja (JSA) dan Studi Bahaya dan Kemampuan Operasi (HAZOPS) di PT Pelindo II (Persero) Cabang Pontianak

Sri Puji Lestari[1*], Linda Suwarni[2], Selviana[3]

[1,2,3] Universitas Muhammadiyah Pontianak, Pontianak, West Kalimantan, 78123, Indonesia.

ARTICLE INFO

Received:
September 23, 2024
Accepted:
November 12, 2024
Published online:
December 07, 2024

***Correspondence:**
lestarisripuji656@gmail.com

Doi:
https://doi.org/10.54630/ijahr.v1i2.74

Keyword:
Risk Analysis, Job Safety Analysis (JSA), Hazard and Operability Study (HAZOPS), Loading and Unloading

ABSTRACT

Loading and unloading companies are at high risk for work accidents. This study aims to identify, assess, and control health and safety risks in the loading and unloading process at PT Pelindo II (Persero) Branch Pontianak in 2021, using the JSA, HAZOPs, and AS/NZS 4360:2004 methods with 60 respondents. The loading and unloading process consists of three sections: Receiving/Delivery, Haulage/Trucking, and Stevedoring, with mechanical hazards being dominant (75%) in Haulage/Trucking and Stevedoring. The risk assessment shows that several work stages have high risks that need to be controlled, while others are acceptable with control. Recommendations include strengthening SOP compliance, using PPE, implementing administrative and engineering controls, as well as periodic training and safety talks to improve work safety awareness.

Kata Kunci:
Analisis Risiko, Job Safety Analysis (JSA), Hazard and Operability Study (HAZOPS), Bongkar Muat

ABSTRAK

Perusahaan bongkar muat berisiko tinggi terhadap kecelakaan kerja. Penelitian ini bertujuan mengidentifikasi, menilai, dan mengendalikan risiko kesehatan dan keselamatan kerja pada proses bongkar muat di PT Pelindo II (Persero) Cabang Pontianak Tahun 2021, menggunakan metode JSA, HAZOPs, dan AS/NZS 4360:2004 dengan 60 responden. Proses bongkar muat terdiri dari tiga bagian: Receiving/Delivery, Haulage/Trucking, dan Stevedoring, dengan bahaya mekanik dominan (75%) pada Haulage/Trucking dan Stevedoring. Penilaian risiko menunjukkan beberapa tahapan kerja memiliki risiko tinggi yang perlu dikendalikan, sementara tahapan lainnya dapat diterima dengan pengendalian. Rekomendasi meliputi penguatan kepatuhan SOP, penggunaan APD, pengendalian administrasi dan rekayasa teknik, serta pelatihan dan safety talk berkala untuk meningkatkan kesadaran keselamatan kerja.

1. INTRODUCTION

Work accidents or accidents caused by work are unplanned and uncontrolled events resulting from the actions or reactions of an object, substance, person, or radiation that lead to injury or other possible consequences[1]. According to data from the International Labour Organization (ILO) in 2013, every 15 seconds, one worker dies worldwide due to work-related accidents or diseases. It is estimated that 2.3 million workers die each year due to work accidents and work-related diseases. More than 160 million workers worldwide suffer from work-related diseases, and 313 million workers experience non-fatal accidents annually[2].

In Indonesia, the number of work accidents increased in 2020. According to data from BPJAMSOSTEK, the number of work accident claims in the first semester of 2020, from January to June, rose by 128 percent. This number increased from 85,109 cases to 108,573 cases[3]. PT Pelabuhan Indonesia II (Persero) Branch Pontianak, located on Jl. Pak Kasih, is a company providing services involved in loading and unloading goods from and to ships. The types of activities in the loading and unloading process include haulage/trucking, stevedoring, and receiving/delivery.

There are three work mechanisms in the loading and unloading process at the port: First, stevedoring is the work of unloading goods from ships to the dock, barge, or truck, or loading goods from the dock, barge, or truck onto ships until they are arranged in the cargo hold using ship cranes or land cranes. Second, cargodoring involves releasing goods from ropes/nets (tackle) at the dock and transporting them from the dock to warehouses or storage yards, or vice versa. Lastly, receiving/delivery is the work of moving goods from stockpiles/places of accumulation in warehouses/storage yards and handing them over to be arranged on vehicles at the warehouse/storage yard door or vice versa.

The hazard risks that can occur involve workers being at risk of experiencing work accidents while performing loading and unloading tasks. Several studies on work risks in loading and unloading activities have found extreme levels of potential hazards, such as the risk of body parts being injured by a chainsaw or being hit by a forklift while moving. These potential risks have very severe consequences, making them a top priority for prevention in order to avoid accidents[4]. Other research noted that the highest risk occurs when touching the power cables of reefer containers, with a risk level of 15.02. This risk can lead to electrocution due to uninspected electrical connections, requiring mitigation within 24 hours to reduce the risk to an acceptable level. Meanwhile, the lowest risk was found in the activity of working in a dirty cargo hold, with a risk level of 8.01, which could potentially cause damage to the cargo[5].

The risk factors for work accidents that are commonly found include unsafe behaviors (Unsafe action) at 88%, unsafe conditions (Unsafe condition) at 10%, or both occurring simultaneously. In Indonesia, the causes of work accidents are unsafe behaviors and equipment. Broadly speaking, there are four main factors that can influence work accidents: human factors, tools or machinery used, materials, and the environment[6].

Based on a preliminary survey using Job Safety Analysis (JSA), Hazard & Operability Study (HAZOPs), and AS/NZS 4360:2004 (risk assessment matrix) on workers at PT Pelindo II Branch Pontianak, the results showed that work accidents occurred in the loading and unloading section three times within three weeks, where the accidents resulted in workers suffering serious or moderately severe injuries. Several issues were identified, including the Safety Talk (also known as Safety Morning Talk or Toolbox

DOI: https://doi.org/10.54630/ijahr.v1i2.74
e- ISSN 3089-1051 / P-ISSN 3090-1073

Meeting), which is a routine meeting held between the supervisor and workers to discuss matters related to Occupational Health and Safety (OHS), such as the latest issues, regulations, work procedures, personal protective equipment (PPE), potential hazards, and others. Additionally, the use of PPE is essential for workers to ensure safety and security in high-risk work environments. This is because there are many potential hazards in the workplace, such as falling heavy objects, injury from production machinery, or exposure to chemicals. Based on field observations during work processes, many workers showed non-compliance or a lack of awareness in using PPE during work activities.

2. METHODS

The research method used is descriptive with an observational approach, where a systematic, factual, and accurate description of the work accident risks during the loading and unloading process is made through observation, and no treatment is applied to the research subjects during the study. This research uses Job Safety Analysis (JSA), Hazard & Operability Study (HAZOPs), and AS/NZS 4360:2004 as references for assessing work health and safety risks. The sampling technique used is random sampling, with a sample size of 60 respondents from a population of 150 at PT Pelindo II Branch Pontianak. The data collection techniques employed are systematic observation, interviews, and the distribution of questionnaires using the JSA (Job Safety Analysis) and HAZOP (Hazard and Operability Study) questionnaires.

The research was conducted at PT Pelabuhan Indonesia II (Persero) Branch Pontianak, located on Jl. Pak Kasih. It began with identifying the potential hazards present. The research emerged from an existing issue, leading to the formulation of the problem and a clear and accurate theoretical foundation.

3. RESULTS

In supporting the operations of Pelabuhan Indonesia II Branch Pontianak, there are a total of 250 workers, consisting of 44 permanent employees and 56 outsourcing or organic employees. Further details show that 150 workers are involved in the loading and unloading process, including Rubber Tyred Gantry (RTG) operators, Container Crane operators, Forklift operators, Reach Stacker operators, Telly men, and Foremen.

PT Pelindo II (Persero) Branch Pontianak operates 24 hours a day. The working hours for non-shift employees are 8 hours per day, 5 days a week. Meanwhile, shift workers involved in loading and unloading operations have varying working hours. For Container Crane operators, a rotating system is used, with each operator working 4 hours per day. RTG operators, head truck drivers, telly men, reach stacker operators, and foremen follow a shift system of 8-hour workdays, divided into 3 shifts each day.

Table 1: Hazard Identification in the Loading and Unloading Process

Hazard Identification	Unloading Process					
	Receiving/Delivery		Haulage/Trucking		Stevedoring	
	N	%	N	%	N	%
Present	8	100%	8	100%	8	100%
Absent	0	0%	0	0%	0	0%

Source: Primary Data, 2024

The hazard identification in the loading and unloading process shows that in the Receiving/Delivery section, which involves directing the ship to the dock and container registration, hazards were identified at every dock (100%). In the Haulage/Trucking section, which involves the transportation and movement of containers from the ship to the chassis hand truck, hazards were identified at every dock (100%). Similarly, in the Stevedoring section, which involves transporting containers by hand truck to the container yard (CY), hazards were identified (100%).

The loading and unloading process, which consists of Receiving/Delivery, Haulage/Trucking, and Stevedoring, includes 5 (five) stages. Hazard identification was conducted at each stage of the loading and unloading process (Receiving/Delivery, Haulage/Trucking, and Stevedoring).

Table 2: Hazard Identification in the Loading and Unloading Stages

Source of Hazard	Receving/Delivery				Haulage/Trucking				Stevedoring	
	Work Step 1		Work Step 2		Work Step 3		Work Step 4		Work Step 5	
	N	%	N	%	N	%	N	%	N	%
Physical	0	0%	2	25%	0	0%	0	0%	1	13%
Chemical	0	0%	0	0%	0	0%	0	0%	0	0%
Biological	0	0%	0	0%	0	0%	0	0%	0	0%
Mechanical	1	13%	0	0%	3	38%	0	0%	0	0%
Ergonomic	0	0%	0	0%	0	0%	1	13%	0	0%

Source: Primary Data, 2024

The hazard identification in the 5 work steps of the loading and unloading stages at 8 docks shows that there is a mechanical hazard at 1 dock during work step 1 (ship docking) at a rate of 13%. In work step 2 (container registration), physical hazards are identified at 2 docks at a rate of 25%. In work step 3 (transporting and moving containers from the ship to the chassis head truck), mechanical hazards are identified at 3 docks, or 38%. In work step 4 (transporting containers by head truck to the container yard), ergonomic hazards are identified at 1 dock, or 13%. Finally, in work step 5 (transporting and moving containers from the chassis to the container yard), physical hazards are identified at 1 dock, or 13%.

In the hazard identification for the loading and unloading process at 8 docks, there are 3 potential hazards that could lead to work accidents: physical and mechanical. The risk assessment for the likelihood level shows that 1 dock has a likelihood level of “Likely to occur” at 13%, while 3 docks have a likelihood of “Unusual” at 38%. The “Low likelihood” level is present at 2 docks, or 25%, and 2 docks show a “Rare occurrence” likelihood level, also at 25%.

4. DISCUSSIONS

a. Hazard Potential

In the loading and unloading process, there are 3 main activities: Stevedoring, Haulage/Trucking, and Receiving/Delivery, which are carried out 24 hours a day. The identification results using the Job Safety Analysis (JSA) worksheet and Hazard & Operability Study (HAZOPs) show that some workers identified hazards in each loading and unloading activity, including Stevedoring, Haulage/Trucking, and Receiving/Delivery.

DOI: https://doi.org/10.54630/ijahr.v1i2.74
e- ISSN 3089-1051 / P-ISSN 3090-1073

This is because the loading and unloading process involves the use of lifting and transportation equipment such as Rubber Tyred Gantry (RTG), Container Crane (CC), Forklift, Reach Stacker, and Head Truck. During operations, the operators follow specific instructions from the Telly Man to ensure that the lifting and movement of containers are carried out correctly and placed in the proper location..

b. Hazard Identification

The hazard identification in the loading and unloading process in this study shows that in the Receiving/Delivery section, which involves directing the ship to the dock and container registration, hazards were identified at every dock (100%). In the Haulage/Trucking section, which involves transporting and moving containers from the ship to the chassis hand truck, hazards were identified at every dock (100%). Similarly, in the Stevedoring section, which involves transporting containers by hand truck to the container yard (CY), hazards were identified at every dock (100%).

The hazard identification in the 5 work steps of the loading and unloading process at 8 docks shows that there is a mechanical hazard at 1 dock during work step 1 (ship docking) at a rate of 13%. In work step 2 (container registration), physical hazards were identified at 2 docks at a rate of 25%. In work step 3 (transporting and moving containers from the ship to the chassis head truck), mechanical hazards were identified at 3 docks, or 38%. In work step 4 (transporting containers by head truck to the container yard), ergonomic hazards were identified at 1 dock, or 13%. Finally, in work step 5 (transporting and moving containers from the chassis to the container yard), physical hazards were identified at 1 dock, or 13%. The results of this study are consistent with the research conducted by Senjayani (2015), which identified 17 potential hazards. The risk assessment showed that 7 potential hazards were categorized as low risk, 6 potential hazards were categorized as medium risk, and 4 potential hazards were categorized as high risk in the container loading and unloading work performed by workers using cranes[7].

c. Hazard Sources

The sources of hazards in the loading and unloading process include mechanical, chemical, biological, physical, and ergonomic hazards. The univariate table shows that the hazards present in the loading and unloading process at PT Pelindo Pontianak are mechanical hazards (41%) and physical hazards (28%). According to the observations, in the 3 work stages—Stevedoring, Haulage/Trucking, and Receiving/Delivery—the work positions are not physiologically optimal, such as the head-down position and continuous sitting during container handling by operators of CC, RTG, and Head Trucks. These positions have the potential to cause fatigue and pain in the lower back or spine, which can extend to the buttocks and thighs (low back pain).

d. Risk Assessment

Risk assessment for accidents in the loading and unloading process is one of the preventive actions to reduce the risk of accidents in the workplace. This is in line with Law No. 1 of 1970 concerning Occupational Safety, Article 3, paragraph 1: “With regulations, safety conditions are set to prevent and reduce accidents”[8].

Risk assessment in the loading and unloading process is based on the AS/NZS 4360:2004 criteria, considering the likelihood (Probability) and severity (Consequence) levels. The assessment of the likelihood (Probability) in this study shows that at dock 1, the likelihood level is “Likely to occur”, at docks 2, 3, and 4, the

likelihood level is “Unusual”, at docks 5 and 6, the likelihood level is “Low likelihood”, and at docks 7 and 8, the likelihood level is “Rare occurrence”.

The assessment of the severity (Consequence) in the loading and unloading process in this study shows that at dock 1, the severity level is “Disaster”, at docks 2 and 3, the severity level is “Very Serious”, at dock 4, the severity level is “Disaster”, at dock 5, the severity level is “Serious”, and at docks 6, 7, and 8, the severity level is “Important”.

Several studies have identified common risk factors in loading and unloading operations. Human error is an important factor in accidents, such as errors in actions during the loading and unloading of petroleum products, which are very common and therefore require control actions such as training and monitoring[9]. Similarly, human errors such as improper operations and incorrect instructions are crucial in the loading and unloading of refined oil[10]. Equipment Quality and Maintenance also contribute to risk factors, where equipment failure due to poor maintenance or mechanical issues is often the cause of accidents. For instance, failures of mechanical, electrical, or hydraulic components are high-risk factors in mining operations[11]. In container terminals, equipment maintenance issues contribute to risks such as worker injuries caused by falling containers[12]. Environmental conditions can also affect safety. Poor site conditions have been identified as a high-risk factor in mining operations[11].

e. Risk Control

Risk control is the final step in identifying and assessing the risk of work accidents. This stage outlines effective ways to address potential hazards in the work environment. Before determining the appropriate control methods, it is necessary to establish a priority scale, followed by the selection of risk controls, one of which is the hierarchy of control. The hierarchy of control involves controls that match the needs of each activity that carries work risks. These controls include elimination, substitution, engineering controls, administrative controls, and personal protective equipment (PPE).

In the loading and unloading process, at the first stage (Ship Docking), the risk level is undesirable (Undesirable), so the recommended risk control is to follow the Standard Operating Procedures (SOP), Work Instructions, or Work Guidelines, and use personal protective equipment (PPE). At the second stage (Container Registration by Tally Man), with an undesirable risk level (Undesirable), the risk control involves following SOP, working physiologically (taking breaks), and using PPE. At the third stage (Transporting and Moving Containers from the Ship to the Chassis Head Truck), with an acceptable with control risk level (Acceptable with control), the recommended risk control is regular equipment maintenance & inspection, following SOP, and using PPE. At the fourth stage (Transporting Containers by Head Truck to the Container Yard), with an undesirable risk level (Undesirable), the recommended risk control is regular equipment maintenance & inspection, following SOP, working physiologically (taking breaks), and using PPE. At the fifth stage (Transporting and Moving Containers from Chassis to CY), with an undesirable risk level (Undesirable), the recommended risk control is regular equipment maintenance & inspection, following SOP, working physiologically (taking breaks), and using PPE.

Several studies recommend risk mitigation strategies, including training and monitoring: routine training sessions and the development of monitoring checklists can help reduce human errors[9]. Preventive maintenance: ensuring regular equipment maintenance can prevent mechanical failures and reduce accident risks[11,12]. Safety

DOI: https://doi.org/10.54630/ijahr.v1i2.74
e- ISSN 3089-1051 / P-ISSN 3090-1073

protocols: implementing strict safety protocols and procedures can minimize risks associated with environmental factors and human errors[10,12].

5. CONCLUSIONS

Based on the research findings on accident risks in the loading and unloading process at PT Pelindo II (Persero) Branch Pontianak using the JSA and HAZOPs methods, it can be concluded that the loading and unloading process consists of three main sections: Receiving/Delivery, Haulage/Trucking, and Stevedoring. Mechanical hazards dominate, with the highest risk in Haulage/Trucking (70%) and Stevedoring (76.7%). The risk assessment shows that the first, second, fourth, and fifth stages have undesirable risks, while the third stage is acceptable with control. Risk control is carried out through adherence to SOP, engineering controls, and the use of PPE.

The recommendations are administrative control and engineering controls for stages with high risks, and administrative control and PPE use for stages that are acceptable with control. PT Pelindo II (Persero) is expected to collaborate with the government to increase awareness through safety talks. Future research is recommended to use the HIRAC method to explore other factors that affect work accidents.

6. ACKNOWLEDGEMENTS

The author would like to express gratitude to PT Pelindo II Branch Pontianak for granting permission to conduct the research.

Author Contributions

SPJ: As the principal researcher, responsible for designing, implementing, and analyzing the research data; LS: Provided guidance in research methodology and data analysis; S: Offered input related to the preparation of the report and the interpretation of research results.

7. REFERENCES

1. Indraswari P.J PPA, Norken IN, Suthanaya PA. Manajemen Risiko Perencanaan Pembangunan Infrastruktur Pelabuhan Benoa. *JURNAL SPEKTRAN*. 2018;6(2). Accessed August 10, 2025. https://ojs.unud.ac.id/index.php/jsn/article/view/42298

2. International Labour Organization (ILO). *Keselamatan Dan Kesehatan Di Tempat Kerja Sarana Untuk Produktivitas : Pedoman Pelatihan Untuk Manajer Dan Pekerja Modul Lima*. ILO; 2013.

3. SPNEWS. Tingkatkan Produktivitas Dengan Menerapkan K3 - Serikat Pekerja Nasional. Accessed August 10, 2020. https://spn.or.id/tingkatkan-produktivitas-dengan-menerapkan-k3/

4. Novitasari BP, Saptadi S. Analisis Risiko Kecelakaan Kerja Dengan Metode Job Safety Analysis Pada Dermaga Pelabuhan Dalam Pt. Pelabuhan Indonesia Iii Cabang Tanjung Emas. *Industrial Engineering Online Journal*. 2018;7(3). Accessed August 10, 2025. https://ejournal3.undip.ac.id/index.php/ieoj/article/view/22252

5. Maulana Politeknik Pelayaran Surabaya A, Hasugian Politeknik Pelayaran Surabaya S, Widada Politeknik Pelayaran Surabaya H, Agung Istri Sri Wahyuni Politeknik Pelayaran Surabaya A, Politeknik Pelayaran Surabaya A. Identifikasi Risiko Kegiatan Bongkar Muat Untuk Mengendalikan dan Mencegah Kecelakaan Kerja Dengan Menggunakan Metode Hazop Analysis di Mv. Tanto Permai. *JURNAL SAINS DAN TEKNOLOGI MARITIM*. 2023;24(1):61-80. doi: https://doi.org/10.33556/JSTM.V24I1.359

6. Suarjana IWG. *Buku Aja Dasar Kesehatan Dan Keselamatan Kerja*. Eureka Media Aksara; 2022.

7. Senjayani P, Martiana T. Penilaian Dan Pengendalian Risiko Pada Pekerjaan Bongkar Muat Peti Kemas Oleh Tenaga Kerja Bongkar Muat Dengan Crane. *Journal of Public Health Research and Community Health Development*. 2018;1(2):120-130. doi: https://doi.org/10.20473/JPHRECODE.V1I2.16244

8. Peraturan Presiden RI. *Undang-Undang Republik Indonesia Nomor 1 Tahun 1970 Tentang Keselamatan Kerja*.; 1970.

9. Aliabadi MM, Mohammadfam I, Khorshidikia S. Human error identification and risk assessment in loading and unloading of petroleum products by road trucks using the SHERPA and fuzzy inference system method. *Heliyon*. 2024;10(15). doi: https://doi.org/10.1016/J.HELIYON.2024.E34072

10. Liu Z, Jia L, Dong S. Refined Oil Loading and Unloading Process Risk Assessment using Stochastic Colored Petri Nets Integrated with Risk Factors. *Tehnicki Vjesnik*. 2024;31(1):70-78. doi: https://doi.org/10.17559/TV-20230212000350

11. Md-Nor Z, Kecojevic V, Komljenovic D, Groves W. Risk assessment for loader- and dozer-related fatal incidents in U.S. mining. *Int J Inj Contr Saf Promot*. 2008;15(2):65-75. doi: https://doi.org/10.1080/17457300801977261

12. Sunaryo, Hamka MA. Safety risks assessment on container terminal using hazard identification and risk assessment and fault tree analysis methods. *Procedia Eng*. 2017;194:307-314. doi: https://doi.org/10.1016/J.PROENG.2017.08.150