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A Cross Sectional Study of Accident Among Prime Mover Operator at Port

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Abstract

Accidents involving prime mover operators at port container terminals pose significant risks to both personnel and infrastructure. This cross-sectional study aims to investigate the frequency, characteristics, contributing risk factors, and preventive practices associated with accidents among prime mover operators at a well-defined port location. By encompassing the entire population, the study provides comprehensive insights into the challenges and risk factors faced by prime mover operators, including human factors, vehicle factors, road and environmental factors, and weather condition factors. Data collection involves two approaches administering a structured questionnaire survey as primary data and secondary data using journals etc. Data was collected via a questionnaire distributed among 321 prime mover operators. Utilizing SPSS version 29 software, the chapter meticulously analyses various aspects of the collected data. Surprisingly, the response rate exceeded expectations at 101%, indicating a higher engagement than anticipated. Reliability analysis revealed a strong internal consistency among measured items, denoted by a Cronbach's Alpha value of 0.910. Demographic analysis highlighted that the majority of respondents were male, aged between 26 and 40, with 1 to 2 years of work experience, predominantly single, Malaysian citizens, and possessing secondary-level education. Regarding accidents, most reported no involvement, while different types and characteristics of accidents were detailed. In conclusion, this study has shown that the significant level of the human factor is high (mean=4.02), the vehicle factor is high (3.82), the road and environment factor is medium (3.10) and the weather condition factor is low(1.52). Lastly, intervention program preferences were explored, highlighting varying participation rates among different safety measures. Overall, this study provides a comprehensive and insightful examination of prime mover operators' accidents, demographics, risk factors, and intervention preferences, offering valuable insights for enhancing safety measures in this domain.

1. Introduction

A port terminal, referred to as a marine terminal or port facility, serves as a dedicated zone within a port that specializes in the efficient transfer of goods between ships and other modes of transportation, such as

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trucks and trains [1]. It encompasses a dock or quay for ship mooring, alongside an array of cargo-handling machinery like cranes, prime movers, forklifts, and conveyor systems [2]. Additionally, the terminal often incorporates storage facilities like warehouses and yards to temporarily house cargo before onward transportation to its final location.

Working in a port can be a high-risk job due to various activities and factors. Some of the high-risk activities in a container port include container handling. The process of loading and unloading containers from ships to yards involves heavy machinery like quay cranes, rubber tire gantry cranes, and prime movers. Heavy machinery can lead to accident cases for several reasons. This reason includes human factor [3], vehicle factor [4], road and environment factor [5], and weather condition factor [6].

This study aims to investigate the root cause of accidents involving the prime mover in the port container terminals and to propose preventive actions to overcome them. Thus, to achieve the aims, three research objectives serve as a solid foundation for studying accidents involving prime mover operators at the port. The first is to investigate the frequency and characteristics of accidents involving prime mover operators. This study also analyses the contributing risk factors of accidents involving prime movers. And lastly, propose intervention programs that specifically address these factors, thereby reducing the occurrence of accidents.

2. Methodology

2.1 Research Design

A questionnaire consisting of four sections was constructed to collect all relevant information from correspondence. The data were analyzed with the usage of Statistical Package for the Social Sciences (SPSS) version 29.

2.2 Data Collection Method

In this study, primary data was collected using a specific questionnaire tailored for gathering information directly from prime mover operators in port environments. Additionally, secondary data, comprising existing literature, articles, news, and official documents from various research projects, was incorporated. This supplementary information provides additional context and insights into accidents among prime mover operators at ports, complementing the primary data obtained through the questionnaire. The total population for this research study was 317 individuals. Surprisingly, 321 people participated and responded, resulting in a response rate of 101%. This means that more people participated than initially expected from the population, indicating a higher engagement or willingness to contribute to the study than anticipated.

2.3 Descriptive analysis

Descriptive statistics involve numerical and graphical tools to summarize key aspects of datasets. They include measures like mean, median, mode (central tendency), and standard deviation, range, variance (dispersion). Descriptive statistics are fundamental for simplifying data and aiding in its interpretation. All the collected data was analyzed using SPSS software version 29. Table 1 shows the mean score used for descriptive analysis.

Table 1: *Mean score*

NO	MEAN VALUE	RATING
1.	3.68 – 5.00	High (H)
2.	2.34 – 3.67	Medium (M)
3.	1.00 – 2.33	Low (L)

3. Result and Discussion

The results were constructed to achieve the aim and objectives of the research. The data is then processed and analyzed by a software called SPSS version 29. Table 2 shows the reliability value of the overall factor, which is high, 0.910. It shows overall understanding of the respondent is consistent. The questionnaire validation was confirmed by the safety officer at the Port.

Table 2: *Overall respondent reliability*

Cronbach's Alpha	N of Items
0.910	15

3.1 Demographic Analysis

Table 3 shows that most of the individuals surveyed identify as male, making up 89.7% of the group, while females account for 10.3%. In terms of age, a significant number fall between 26 and 40 years old, making up 78.2% of the respondents. Additionally, a large portion of people have 1 to 2 years of work experience (40.8%), and the majority are single (86.3%). The data also shows that most people are citizens of Malaysia (68.8%), with smaller percentages from Bangladesh (9.0%), Pakistan (10.0%), Nepal (10.9%), and other countries (1.2%). When it comes to education, a considerable percentage completed secondary school (70.7%), followed by primary school (20.2%), and holders of diplomas (7.5%), while those with a bachelor's degree are fewer (1.2%). This comprehensive analysis gives us a solid understanding of the demographic makeup of this surveyed group, which is crucial for conducting deeper studies or creating specific interventions tailored to this population

Table 3: *Characteristics of respondent*

Demographic	Frequency	Percentage
1. Gender		
Male	288	89.7
Female	33	10.3
2. Age		
18 - 25 years old	14	4.4
26 - 35 years old	115	35.8
36 - 40 years old	136	42.4
Above 40	56	17.4
3. Working Experience		
Below 6 months	10	3.1
6 - 12 months	103	32.1
1 years to 2 years	121	40.8
Above 2 years	77	24.0
4. Marital Status		
Single	277	86.3
Married	42	13.1
Others	2	0.6
5. **Citizenship**		
Malaysia	221	68.8
Bangladesh	29	9.0
Pakistan	32	10.0
Nepal	35	10.9
Others	4	1.2
6. **Educational Level**		
Primary School	65	20.2
Secondary School	227	70.7
Diploma	24	7.5
Bachelor	4	1.2
Others	1	0.3

3.2 Frequency and characteristic of accidents among prime mover operators

3.2.1 Accident frequency

From the analysis conducted, the findings in Table 4 show the breakdown of individuals based on their involvement in accidents among 321 respondents. The majority (205 individuals) reported no accidents, making up 63.9% of the total sample. Additionally, 92 respondents (28.7%) reported one accident, while a smaller group of 24 individuals (7.5%) reported multiple accidents. This table offers a concise view of accident involvement

among the surveyed population, emphasizing that most respondents had no accidents, followed by smaller groups reporting one or multiple incidents.

Table 4: *Frequency of accident*

	Frequency	Percent
Never Involve In an Accident	205	63.9
1 time	92	28.7
More	24	7.5
Total	321	100.0

3.2.2 Accident characteristic

The data analysis of accidents within the surveyed context reveals noteworthy trends. Table 5 shows that Kalma's prime mover accidents occurred more frequently than Terberg prime mover incidents, constituting 23.4% (75 occurrences) and 12.8% (41 occurrences) respectively, indicating a higher prevalence of Kalma-related accidents. Secondly, incidents involving Prime Mover (PM) highlight prevalent scenarios, with PMs frequently involved in collisions: PM hitting another PM (37 cases), structures (32 cases), and other vehicles (21 cases). Notably, specific occurrences involving PMs toppling (8 cases) and jack-knifing (4 cases) were also recorded, emphasizing diverse incident types. Thirdly, location-wise distributions demonstrate varying frequencies of accidents across distinct areas within the port or terminal. The Wharf Main Road recorded the highest incidence rate (16.8%, 54 incidents), followed by the Yard Main Road (10.9%, 35 incidents) and the Container Yard (8.4%, 27 incidents), suggesting different focal points for safety enhancements. Lastly, the temporal breakdown reveals higher incident rates during nighttime (22.7%, 73 occurrences) compared to daytime (62%, 43 occurrences), indicating a tendency for more accidents during night hours within the surveyed context. These insights underline specific areas for potential safety improvements and emphasize the need for targeted measures to reduce accidents, especially in higher-risk scenarios and times.

Table 5: *Accident characteristics*

Item	Frequency	Percent
Type of PM		
Kalma	75	64.66
Terberg	41	35.34
Type of accident		
PM hit PM	34	29.31
PM hit structure	31	26.72
PM hit other vehicles	21	18.10
PM hit RTG	14	12.07
PM topple	1	0.86
PM jack knife	1	0.86
Others	3	2.59
Location of accident		
Container yard	27	23.28
Yard main road	35	30.17
Wharf main road	54	46.55
Shift pattern		
Day	43	37.07
Night	73	62.93

3.3 Risk Factor Level

3.3.1 Human Factor

According to Table 6, The statistical analysis of the Human Factor indicates a mean score of 4.04, with a standard deviation of 0.83. This mean score suggests a notably high level within this factor, indicating a substantial presence or impact of human-related elements within the considered context or domain.

Table 6: *Human factor*

Factor	Mean	Standard Deviation	Significant
Human Factor	4.02	0.84	High

Table 7 displays the mean scores and significance levels for various factors contributing to the overall assessment. Fatigue, Distraction, Inexperience, Lack of training, and No driving license showcase mean scores ranging from 3.82 to 3.95, all identified as significantly high. These factors collectively highlight the pronounced influence of human-related aspects on the assessed domain. Furthermore, the factor of Difficulty measuring safe distance stands out notably with a mean score of 4.85, indicating a substantially higher impact compared to other elements evaluated, and is also categorized as highly significant.

Table 7: *Mean scores and significant levels for human factors*

Items	Mean	Significant
Fatigue	3.82	High
Distraction	3.83	High
Inexperience	3.95	High
Lack of training	3.95	High
No driving licence	3.86	High
Difficulty measuring safe distance	4.73	High

3.3.2 Vehicle Factor

Table 8 depicts the analysis of the Vehicle Factor, indicating a mean score of 3.82 with a standard deviation of 1.02. The findings suggest a high significance level within this factor, signifying a notable impact or presence of vehicle-related elements within the evaluated context.

Table 8: *Vehicle Factor*

Factor	Mean	Standard Deviation	Significant
Vehicle Factor	3.82	1.02	High

Table 9 presents the mean scores and significance levels for specific aspects related to the Vehicle Factor. Brake failure, Tire problem, and Steering problem exhibit mean scores ranging from 3.76 to 3.93, all of which are classified as significantly high. The high significance levels associated with brake failure, tire problems, and steering issues emphasize their noteworthy impact on the overall evaluation of the Vehicle Factor.

Table 9: *Mean scores and significant levels for vehicle factors*

Items	Mean	Significant
Brake failure	3.76	High
Tire problem	3.79	High
Steering problem	3.93	High

3.3.3 Road and Environment Factor

Table 10 presents the statistical analysis for the Road and Environment Factor, showing a mean score of 3.85 and a standard deviation of 0.97. This mean score signifies a notable impact or prevalence of factors related to road conditions and the environment within the context being assessed. The mean value, along with a moderately sized standard deviation, suggests a relatively consistent trend regarding this factor. However, the standard deviation also implies a moderate degree of variability among data points. This variability indicates diverse influences or perceptions concerning road and environmental elements, despite their consistent classification as significantly impactful within the overall assessment.

Table 10: *Road and Environment Factor*

Factor	Mean	Standard Deviation	Significant
Road and Environment Factor	3.10	0.69	Medium

The analysis presented in Table 11 highlights specific elements within the Road and Environment Factor, showcasing their mean scores and significance levels. Potholes, Uneven surfaces, Road and construction at the workplace, and Poor lighting exhibit mean scores ranging from 3.73 to 3.93, all categorized as significantly high. These findings emphasize the substantial influence of these individual environmental aspects within the assessed context. The high significance levels associated with potholes, uneven surfaces, road and construction at the workplace, and poor lighting underscore their noteworthy impact on the overall evaluation of the Road

and Environment Factor. These results suggest a critical need for attention and potential mitigation strategies addressing these environmental elements to enhance safety and conditions within the evaluated domain.

Table 11: *Mean scores and significant levels for road and environmental factors*

Items	Mean	Significant
Pothole	2.83	Medium
Uneven surface	3.93	High
Road and construction at workplace	3.92	High
Poor lighting	1.71	Low

3.3.4 Weather Condition Factor

In Table 12, the analysis of the Weather Condition Factor indicates a relatively low mean score of 1.52, accompanied by a standard deviation of 0.32. This factor is considered to have low significance within the assessed context. The low mean value suggests a limited influence or impact of weather-related elements on the overall evaluation. Additionally, the low standard deviation indicates a relatively narrow range of observations around the mean, signifying a consistent trend in the data points associated with weather conditions. Consequently, while weather conditions seem to have a minor impact based on this assessment, further investigation or consideration might be necessary to understand their potential implications comprehensively.

Table 12: *Weather Condition Factor*

Factor	Mean	Standard Deviation	Significant
Weather Condition Factor	1.52	0.32	Low

Within the Weather Condition Factor in Table 13, specific elements such as Rain, Fog, and Scorching hot exhibit mean scores ranging from 1.23 to 1.76, all of which are classified as having low significance. These findings suggest a minimal impact of these individual weather-related factors within the assessed context. The low mean scores indicate a limited influence or relevance of rain, fog, and scorching hot conditions on the overall evaluation. This assessment implies that these weather elements might have fewer substantial implications compared to other factors considered in the analysis. However, despite their low significance, these weather conditions could still potentially contribute to specific challenges or considerations that warrant attention within the evaluated domain.

Table 13: *Mean scores and significant levels for weather condition*

Item	Mean	Significant
Rain	1.23	Low
Fog	1.76	Low
Scorching hot	1.59	Low

3.4 Intervention Program

Table 14 reveals the respondents' varying levels of engagement and support for different intervention programs aimed at reducing accidents involving prime mover operators. Among the interventions considered, Refresher Training emerged as the most popular, with a substantial majority (60.4%) actively participating in such programs. In contrast, Toolbox Talk, Better Lighting in Terminal, and Road Terminal interventions garnered notably lower support, with participation rates of 12.5%, 15.3%, and 26.2% respectively, indicating limited enthusiasm or recognition of their potential effectiveness. Prime Mover Maintenance and Engagement landed in the middle ground, with participation rates of 46.1% and 29.9% respectively, suggesting moderate but not overwhelming support for these interventions. These insights emphasize the need to prioritize interventions based on participant inclinations and preferences to effectively enhance safety measures concerning prime mover operations.

Table 14: *Intervention Program*

Item	Frequency	Percent
Toolbox Talk		
Yes	40	12.5
No	281	87.5
Refresher Training		
Yes	194	60.4
No	127	39.6
Prime Mover Engagement		
Yes	96	29.9
No	225	70.1
Prime Mover Maintenance		
Yes	148	46.1
No	173	53.9
Better Lighting in Terminal		
Yes	49	15.3
No	272	84.7
Road Maintenance		
Yes	84	26.2
No	237	73.8

4. Conclusion

This research represents a comprehensive overview derived from data collected via a questionnaire distributed among 321 prime mover operators. Utilizing SPSS version 29 software, the chapter meticulously analyses various aspects of the collected data. Surprisingly, the response rate exceeded expectations at 101%, indicating a higher engagement than anticipated. Reliability analysis revealed a strong internal consistency among measured items, denoted by a Cronbach's Alpha value of 0.910. Demographic analysis highlighted that the majority of respondents were male, aged between 26 and 40, with 1 to 2 years of work experience, predominantly single, Malaysian citizens, and possessing secondary-level education. Regarding accidents, most reported no involvement, while different types and characteristics of accidents were detailed. In conclusion, this study has shown that the significant level of the human factor is high (mean=4.02), the vehicle factor is high (3.82), the road and environment factor is medium (3.10) and the weather condition factor is low (1.52). Lastly, intervention program preferences were explored, highlighting varying participation rates among different safety measures. Overall, the result and discussion provide a comprehensive and insightful examination of prime mover operators' accidents, demographics, risk factors, and intervention preferences, offering valuable insights for enhancing safety measures in this domain.

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Conflict of Interest

The authors declare that there is no conflict of interests regarding the publication of the paper.

Author Contribution

All authors of this study have a complete contribution for data collection, data analyses and manuscript writing.

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