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ANALYZING THE PATTERN OF NEAR MISS AND INJURY BY FOCUSING ON CRANES IN THE MARITIME INDUSTRY

Tamaraebi Atuwo[1], Temitope Oluwadairo[2]

Abstract - *This project explores maritime crane near miss and injury events. This project research aims to determine if the analysis near miss reports can be used to predict injury incidents for maritime cranes. To achieve this aim, data was obtained containing 2,353 near miss incidents and 305 injury incidents. These incidents were then classified into specific subgroups based on 23 different criteria such as Type of Event, Cause of Incident, and Incident Triggers. For example, for the Cause of Incident criteria, incidents could be classified as "People", "Equipment", "Communication", "Organization" and "Other". The relative proportions of near miss and injury incidents within the subgroups of a criteria were then compared using qualitative and statistical methods. The results show that the proportions near miss and incidents within the subgroups of all but one of the 23 criteria (Cause of Incident) did not follow the same pattern (Pearson Chi2 test for fit, p-value < 0.5). This result suggestion shows that near misses and injuries are different with near misses for operator error, inattention, or improper rigging of cranes being less frequent than anticipated by their occurrence in injuries. This research also identifies common problems and human errors associated with maritime cranes.*

Key Words: **Near Misses, Injury, Analytical Hierarchy Process, Cranes.**

1. INTRODUCTION

The prevention of occupational injuries through near-miss reporting and investigation assumes that the causes of injuries and near misses are similar[1]. If the above assumption is true, then analyzing the causes of near misses, which occur more frequently than injuries, would provide insight into potential causes of injuries.

The validity of this assumption has however been questioned leading to a debate on the usefulness of near misses in the prevention of occupational injuries[2, 3]. The primary aim of this research is to determine if near misses predict injuries within a specific activity in a specific industry.

Cranes are machines used for the lifting, lowering and the horizontal movement of loads, through a hoisting mechanism. According to reports from the Bureau of Labor Statistics, fatalities related to cranes for years 2012, 2013 and 2014 were 47, 43 and 48 respectively(Bureau of Labor Statistics 2018b). The major causes of death from crane related incidents in the United States that have been identified as; "Contact with object or equipment (62%), Falls (20%), Transportation incidents (10%), and Contact with electrical current (8%)". (Bureau of Labor Statistics 2017a) Stress and fatigue have also been determined to be important root causes that lead to the occurrence of work related incidents[5, 6].

OSHA encourages the investigation of both near misses (close calls) defined as an event in "which a worker might have been hurt had the situation been different" as well as other incidents (an event leading to injury, illness, loss of property). Analyzing near miss incidents has been proposed as a useful tool for the prevention of injuries and accidents in the occupational setting. The "Common Cause Hypothesis", proposed by Heinrich, postulates that both major incidents and minor incidents have similar causal patterns[1]. Since near-misses occur at a much higher frequency than major incidents, more data will be available for study when analyzing near misses compared to major incidents. Wu et al, in 2010, presented a systematic model for improving safety on construction sites by emphasizing on the real-time tracking of precursors and immediate factors associated with incidents on these sites[8]. Similarly, Cambraia et al. presented guidelines that may be used to identify, analyze and disseminate information on near misses at construction sites[9]. Also, Gnoni et al. stated the importance of a Near-miss Management System (NMS) as a critical component of any safety management system[10].

Studies have shown that major causes of underreporting of near misses include blame culture within the organization, safety climate within an organization, an attitude of top management towards safety, and subjective definitions of what constitute a near miss[11-13]. To prevent underreporting of near misses scientific tools to assess the safety climate within an organization has been developed[14].

Despite the widespread use of near-miss studies in several industries, the debate still rages on about the usefulness of near-miss studies. Wright et al, who studied data from the United Kingdom railways, testing the common cause hypothesis[7]. On the other hand, some studies have rebutted the claim that near miss and major incidents follow the same causal patterns. Petersen in 1971 and Salminen et

al. in 1992, and also Saloniemi and Oksanen in 1998 are good examples for investigating this idea.

Regarding cranes in the maritime industry, few studies have analyzed the use of near miss as a tool in the prevention of incidents and the difficulties associated with the use of this tool. One study has been done in 2012, analyzed both internal maritime incident and near miss reporting systems in shipping companies in Finland and Sweden and found that a no blame culture, good communication between ship and land based organizations and strong commitment from top management are crucial to the efficient use of near miss in a safety management system[15].

Studies were needed which would test the hypothesis that major and minor incidents have similar causal patterns. While different studies exist testing this hypothesis in various forms[2, 16], none of these studies have been carried out studying incidents related to cranes in the maritime industry. Therefore, in this study, we compared the causal patterns associated with crane related near misses to those associated with other crane related workplace incidents, in a maritime company. We determined if the causes of these near misses and other workplace incidents followed the same pattern.

2. METHOD

2.1. Data Collection and Coding

A data set containing injury and near miss records for a maritime company located in the United States was obtained. Included in the data were the, incident type, location of incident, vessel type, equipment involved, descriptions of the events leading up to each incident, the resolution of each incident and the corrective actions taken. The data set for injuries and near miss was coded to subdivide the incidents into groups based on the 23 criteria.

2.1.1. Near Miss

To determine the causal pattern for near miss incidents, information on all the near miss incidents was analyzed. The incidents were grouped based on 23 specific criteria reported in the coding section. Each incident was placed in one subgroup under each of the 23 criteria based on the information provided in the data set. The process of sorting the incidents into their subgroups involved two researchers working separately. Both researchers first placed each incident into one subgroup for each of the 23 criteria separately. Both researchers had to agree on a subgroup before confirming the grouping of an incident.

2.1.2. Injury

A process like the above process used for near misses was used to sort the injury incidents in to subgroups based on the same 23 criteria mentioned above.

2.2. Statistical Analysis

After grouping all the incidents, injury incidents were compared to near miss incidents based on the proportion of each type of incident within the subgroups of a specific criterion. A similar causal pattern between near miss and injury for a specific criterion occurs if, the distribution of the proportions of near miss incidents across the subgroups of a specific criterion is similar to the distribution of the proportions of injury incidents across the subgroups of the same criterion.

Statistical analysis was carried out using the STATA statistical software package version 15. The Pearson's Chi-squared test for homogeneity was conducted to determine if the distribution of the proportions for Injuries and Near Misses within the subgroups of each criterion were statistically different due to the P-values less than 0.05 which indicate that injuries and near misses do not follow a similar pattern statistically. Similarly, a G-test or likelihood ratio test was conducted and P-values less than 0.05 indicate the accuracy of Pearson's Chi-squared test.

3. RESULT

A total of 2,658 incidents were analyzed in this study. Of the 2658 incidents, 305 were classified as injury incidents while 2,353 were classified as near miss incidents. All incidents were further classified based on the 23-criterion listed above and analyzed based on the proportion of near miss or injury in each category.

3.1. Similarity Measures

3.1.1. Type of Event

Table 3-1 compares near miss and injury proportions found in each subcategory of Type of Event. In this case, the varying differences in Near Miss and Injury proportions show not similarity across all categories.

Table 3-1: Comparison of Near Miss Proportion to Injury Proportion by Type of Event

Type of Event	Near Miss (%)	Injury (%)	Difference (%)
Struck by	27.62	47.21	-19.59

Falling Object	21.21	11.48	9.73
Other	20.23	8.85	11.38
Fall	10.67	10.82	-0.15
Unspecified	9.99	0.33	9.66
Slip/Trip	7.05	12.46	-5.40
Use of Tools	3.23	8.85	-5.62
Total	100.00	100.00	0.00

Pearson chi2 = 126.5584 (Pr = 0.000)

Likelihood-ratio chi2= 141.8770 (Pr = 0.000)

3.1.2. Incident Triggers

Table 3-2 compares near miss and injury proportions found in each subcategory of Incident Triggers. The wide range of difference in proportions among the all subcategories show not similarity across all categories.

Table 3-2: Comparison of Near Miss Proportion to Injury Proportion by Incident Triggers

Incident Trigger	Near Miss (%)	Injury (%)	Difference (%)
Operator Error	16.8	10.8	6.0
Inattention	10.8	13.8	-3.0
Technical Failure in other Equipment	10.4	4.6	5.8
PPE not Used	9.4	0.3	9.1
Technical Failure in Crane	8.9	3.6	5.3
Strong Wind	6.9	5.3	1.6
Improper Rigging	6.1	7.2	-1.1
Unspecified	5.9	12.5	-6.6
Failure of Lifting Accessories	5.0	9.5	-4.5
Other	4.8	9.8	-5.0
Failure in Communication	3.4	4.9	-1.5
Neutralization	2.3	0.7	1.6
of Limit Switch			
No signal person	2.0	0.0	2.0
Load Mishap	1.5	12.8	-11.3
Error of Signal Person	1.5	1.0	0.5
Rail Failure	1.5	1.0	0.5
Limited Visibility	1.2	1.0	0.3
Wrong location of Crane	0.9	0.7	0.2
Horizontal pull of load	0.5	0.7	-0.2
Fatigue of Operator	0.3	0.0	0.3
Total	100.0	100.0	0.0

Pearson chi2= 230.0107, (Pr = 0.000)

Likelihood-ratio chi2= 206.5190 (Pr = 0.000)

3.1.3. Cause of Incident

Table 3-3 compares near miss and injury proportions found in each subcategory of Cause of Incident. The narrow range differences for Cause of Incident suggest that near misses and injuries proportions are similar across the subcategories.

Table 3-3: Comparison of Near Miss Proportion to Injury Proportion by Cause of Incidents

Cause of Incident	Near Miss (%)	Injury (%)	Difference (%)
People	58.73	53.44	5.29
Equipment	22.31	25.25	-2.94
Unspecified	8.16	7.54	0.62
Weather	6.29	7.87	-1.58
Communication	3.4	4.59	-1.19
Organization	1.1	1.31	-0.21
Total	100.0	100	0.0

Pearson chi2 = 4.6783 (Pr = 0.456)

Likelihood-ratio chi2 = 4.5356 (Pr = 0.475)

3.1.4. Type of Crane

Table 3-4 compares near miss and injury proportions found in each subcategory of Type of Crane. The varying differences in near miss and injury proportions show that near misses and injuries proportions are not similar across all categories Type of Cranes.

Table 3-4: Comparison of Near Miss Proportion to Injury Proportion by Type of Cranes

Types of Cranes	Near Miss (%)	Injury (%)	Difference (%)
Provision Crane	50.11	16.07	34.04
Unspecified	25.12	52.79	-27.67
Cargo Crane	18.06	23.28	-5.22
Engine Room Crane	6.71	7.87	-1.16
Total	100	100.0	0.0

Pearson chi2 = 145.2503 (Pr = 0.000)

Likelihood-ratio chi2= 152.1781 (Pr = 0.000)

3.1.5. Location of Incident

Table 3-5 compares near miss and injury proportions found in each subcategory of Location of Incident. The wide range in the difference between near miss and injury proportions show that near misses and injuries proportions are not similar across all categories of Location of Incident.

Table 3-5: Comparison of Near Miss Proportion to Injury Proportion by Location of Incident

Location of Incident	Near Miss (%)	Injury (%)	Difference (%)
Deck	66.04	50.16	15.88
Cargo Area	9.22	12.79	-3.57
Engine Room	7.35	12.79	-5.44
Ashore	6.84	6.56	0.28
Unspecified	4.97	4.26	0.71
Storage Space	1.02	1.97	-0.95
Gangway	0.93	4.26	-3.33
Bunker Tank	0.72	1.31	-0.59
Life Boat	0.64	0.98	-0.34
Wheel House and Bridge Deck	0.59	0.33	0.26
Garbage Space	0.55	0	0.55
Interior Space	0.42	1.31	-0.89
Ballast Tank	0.25	0.33	-0.08
Pump Room	0.17	0.66	-0.49
Accommodation	0.17	0.98	-0.81
Workshop	0.08	0.98	-0.9
Meeting/Recreation Room	0	0	0
Galley	0	0.33	-0.33
Total	100	100	0

Pearson chi2 = 86.0057 (Pr = 0.000)

Likelihood-ratio chi2 = 66.4212 (Pr = 0.000)

3.1.6. Activity at Time of Event

Table 3-6 compares near miss and injury proportions found in each subcategory of Location of Incident. The differences in proportions among the Activity of Time of Event subcategories show that near misses and injuries proportions are not similar across all categories of Incident Triggers.

Table 3-6: Comparison of Near Miss Proportion to Injury Proportion by Activity at Time of Event

Activity at Time of Event	Near Miss (%)	Injury (%)	Difference (%)
Crane Operation	52.61	48.2	4.41
Maintenance	14.45	21.64	-7.19
No Activity	12.75	5.25	7.5
Other	12.11	20	-7.89
Unspecified	8.07	4.92	3.15
Total	100.0	100.0	0.0

Pearson chi2 = 39.3296 (Pr = 0.000)

Likelihood-ratio chi2 = 40.2864 (Pr = 0.000)

3.1.7. PPE Used

Table 3-7 compares near miss and injury proportions found in each subcategory of PPE used. The

differences between near miss and injury proportions show that near misses and injuries proportions are not similar across all categories.

Table 3-7: Comparison of Near Miss Proportion to Injury Proportion by PPE Used

PPE Used	Near Miss (%)	Injury (%)	Difference (%)
Unspecified	86.02	87.87	-1.85
Missing	11.6	4.59	7.01
Used	2.38	7.54	-5.16
Total	100	100	0

Pearson chi2 = 36.5998 (Pr = 0.000)

Likelihood-ratio chi2 = 33.3387 (Pr = 0.000)

3.1.8. Wind Condition

Table 3-8 compares near miss and injury proportions found in each subcategory of Wind Conditions. The narrow range of differences in near miss and injury proportion for wind conditions indicates that near misses and injury follow a similar pattern.

Table 3-8: Comparison of Near Miss Proportion to Injury Proportion by Wind Conditions

Wind Conditions	Near Miss (%)	Injury (%)	Difference (%)
Unspecified	97.66	96.07	1.59
Heavy Wind	1.4	2.62	-1.22
Light Wind	0.93	1.31	-0.38
Total	100	100	0

Pearson chi2 = 3.0693 (Pr = 0.216)

Likelihood-ratio chi2 = 2.6413 (Pr = 0.267)

3.1.9. Lighting/Visibility

Table 3-9 compares near miss and injury proportions found in each subcategory of Lighting/Visibility. The narrow range of differences in near miss and injury proportion for wind conditions indicates that near misses and injury follow a similar pattern.

Table 3-9: Comparison of Near Miss Proportion to Injury Proportion by Lighting/Visibility

Lighting/Visibility	Near Miss (%)	Injury (%)	Difference (%)
Unspecified	99.79	98.36	1.43
Poor	0.17	0.66	-0.49
Good	0.04	0.98	-0.94
Total	100	100	0

Pearson chi2 = 18.7679 (Pr = 0.000)

Likelihood-ratio chi2 = 10.7875 (Pr = 0.005)

3.1.10. Weather Visibility

Table 3-10 compares near miss and injury proportions found in each subcategory of Weather Visibility. The differences in near miss and injury proportion for weather visibility indicates that near misses and injury do not follow a similar pattern.

Table 3-10: Comparison of Near Miss Proportion to Injury Proportion by Weather Visibility

Weather Visibility	Near Miss (%)	Injury (%)	Difference (%)
Rain	0	0.66	-0.66
Clear	0	0	0
Unspecified	100	99.34	0.66
Total	100	100	0

Pearson chi2 = 15.4411 (Pr = 0.000)

Likelihood-ratio chi2 = 8.6717 (Pr = 0.003)

3.1.11. Injury Severity

Table 3-11 compares near miss and injury proportions found in each subcategory of Injury Severity. The difference in proportions among the Injury Severity subcategories show that near misses and injuries proportions are not similar across all subcategories.

Table 3-11: Comparison of Near Miss Proportion to Injury Proportion by Injury Severity

Injury Severity	Near Miss (%)	Injury (%)	Difference (%)
Near Miss	100	0	100
First Aid Case	0	34.43	-34.43
Lost Time Accident	0	0.66	-0.66
Medical Treatment	0	57.7	-57.7
Restricted Work Accident	0	0.33	-0.33
Unspecified	0	6.89	-6.89
Total	100	0.0	100

Pearson chi2 = 2.7e+03 (Pr = 0.000)

Likelihood-ratio chi2 = 1.9e+03 (Pr = 0.000)

3.1.12. Time of Day When Incident Occurred

Table 3-12 compares near miss and injury proportions found in each subcategory of Time of Day when Incident occurred. The narrow range of differences in near miss and injury proportion for Time of Day Incident occurred indicates that near misses and injury may follow a similar pattern.

Table 3-12: Comparison of Near Miss Proportion to Injury Proportion by Time of Day when Incident Occurred

Time of Day when Incident Occurred	Near Miss (%)	Injury (%)	Difference (%)
Unspecified	98.51	98.36	0.15
Night	0.59	0.66	-0.07
Evening	0.38	0.66	-0.28
Morning	0.34	0.33	0.01
Afternoon	0.17	0	0.17
Total	100	100	0

Pearson chi2 = 1.0240 (Pr = 0.906)

Likelihood-ratio chi2 = 1.4159 (Pr = 0.841)

3.1.13. Just Ship Crew Involved in Incident

Table 3-13 compares near miss and injury proportions found in each subcategory of Just Ship Crew Involved in Incident category. The differences in near miss and injury proportion in among the subcategories indicates that near misses and injury do not follow a similar pattern in this category.

Table 3-13: Comparison of Near Miss Proportion to Injury Proportion by Involvement of Outside Staff

Just Ship Crew in Event	Near Miss (%)	Injury (%)	Difference (%)
Yes	96.98	87.21	9.77
No	0.17	1.64	-1.47
Unspecified	2.85	11.15	-8.3
Total	100	100	0

Pearson chi2 = 68.8558 (Pr = 0.000)

Likelihood-ratio chi2 = 47.5424 (Pr = 0.000)

3.1.14. Tone of Report toward Ships Crew

Table 3-14 compares near miss and injury proportions found in each subcategory of the Tone of Report towards Ship's Crew category. The differences in near miss and injury proportion in among the subcategories indicates that near misses and injury do not follow a similar pattern in this category.

Table 3-14: Comparison of Near Miss Proportion to Injury Proportion by Involvement of Tone of Report towards Ship's Crew

Tone of Report Towards Ship's Crew	Near Miss (%)	Injury (%)	Difference (%)
Blame	46.71	79.02	-32.31
Neutral	41.90	0.00	41.90
Unspecified	10.16	15.74	-5.58
Supportive	1.23	5.25	-4.01
Total	100.01	100.00	0.00

Pearson chi2 = 217.1933 (Pr = 0.000)

Likelihood-ratio chi2= 313.7820 (Pr = 0.000)

3.1.15. Tone of Report towards Individuals outside Ship's Crew

Table 3-15 compares near miss and injury proportions found in each subcategory of the Tone of Report towards Individuals outside Ship's Crew category. The differences in near miss and injury proportion in among the subcategories indicates that near misses and injury do not follow a similar pattern in this category.

Table 3-15: Comparison of Near Miss Proportion to Injury Proportion by Involvement of Tone of Report towards Ship's Crew

Tone of Report Towards Individuals Outside of Ship's Crew	Near Miss (%)	Injury (%)	Difference (%)
Only Ship's Crew in Report	79.94	0.33	79.61
Unspecified	11.47	22.95	-11.48
Blame	7.18	8.20	-1.01
Neutral	1.36	0.00	1.36
Supportive	0.04	68.52	-68.48
Total	100.00	100.00	0.00

Pearson chi2 = 1.9e+03 (Pr = 0.000)

Likelihood-ratio chi2 = 1.4e+03 (Pr = 0.000)

3.1.16. Corporate Response Tone

Table 3-16 compares near miss and injury proportions found in each subcategory of the Corporate Response Tone category. The differences in near miss and injury proportion in among the subcategories indicates that near misses and injury do not follow a similar pattern in this category.

Table 3-16: Comparison of Near Miss Proportion to Injury Proportion by Involvement of Tone of Report towards Ship's Crew

Corporate Response Tone	Near Miss (%)	Injury (%)	Difference (%)
No Corporate Response	96.18	37.05	59.13
Blame	2.46	29.84	-27.37
Unspecified	0.93	2.30	-1.37
Supportive	0.38	2.95	-2.57
Neutral	0.04	27.87	-27.83
Total	100.00	100.00	-0.01

Pearson chi2 = 1.1e+03 (Pr = 0.000)

Likelihood-ratio chi2= 718.2621 (Pr = 0.000)

3.1.17. Type of Incident

Table 3-17 compares near miss and injury proportions found in each subcategory of Type of Incident. The wide range of differences in proportions among the Type of Incident subcategories show that near misses and injuries proportions are not similar across all subcategories.

Table 3-17: Comparison of Near Miss Proportion to Injury Proportion by Type of Incident

Type of Incident	Near Miss (%)	Injury (%)	Difference (%)
Hazardous Condition	53.12	2.95	50.17
Non-Contact Incident	28.05	3.28	24.77
Immediate Hazard	7.18	2.3	4.88
Unspecified	4.42	1.31	3.11
Contact Incident without damage	3.65	7.54	-3.89
Contact Incident with damage	3.06	47.87	-44.81
Injury	0.51	34.75	-34.24
Total	100	100	-0.00

Pearson chi2 = 1.6e+03 (Pr = 0.000)

Likelihood-ratio chi2 = 1.1e+03 (Pr = 0.000)

3.1.18. Physical Corrective Measures

Table 3-18 compares near miss and injury proportions found in each subcategory of Physical Corrective Measures. The differences in proportions among the Physical

Corrective Measures subcategories show that near misses and injuries proportions are not similar across all subcategories.

Table 3-18: Comparison of Near Miss Proportion to Injury Proportion by Physical Corrective Measures

Physical Corrective Measures	Near Miss (%)	Injury (%)	Difference (%)
Barriers and Warnings	51.64	50.16	1.48
Repair and Replace	29.54	4.92	24.62
Unspecified	8.88	39.02	-30.14
Clean Up/Minor Repair	8.8	2.3	6.5
Design Changes	1.15	3.61	-2.46
Total	100	100	0

Pearson chi2 = 285.6600 (Pr = 0.000)

Likelihood-ratio chi2= 253.2211 (Pr = 0.000)

3.1.19. Administrative Corrective Measures

Table 3-19 compares near miss and injury proportions found in each subcategory of Administrative Corrective Measure. The differences in proportions among the subcategories show that near misses and injuries proportions are not similar across all subcategories of Administrative Corrective Measures.

Table 3-19: Comparison of Near Miss Proportion to Injury Proportion by Administrative Corrective Measures

Administrative Corrective Measures	Near Miss (%)	Injury (%)	Difference (%)
Verbal instructions to one employee	75.72	0	75.72
Group Instruction	23.49	0	23.49
New Administrative Controls	0.79	0	0.79
Unspecified	0	100	-100
Total	100	100	0

Pearson chi2 = 2.5e+03 (Pr = 0.000)

Likelihood-ratio chi2 = 1.8e+03 (Pr = 0.000)

3.1.20. Cause Analysis

Table 3-20 compares near miss and injury proportions found in the Cause Analysis subcategories. The differences in proportions among the Cause Analysis subcategories show that near misses and injuries proportions are not similar across all categories of Incident Triggers.

Table 3-20: Comparison of Near Miss Proportion to Injury Proportion by Cause Analysis

Cause Analysis	Near Miss (%)	Injury (%)	Difference (%)
Unspecified	99.28	82.95	16.33
No Cause Analysis	0.51	0	0.51
Single Cause Based on Initial Observation	0.13	0	0.13
Multiple Causes	0.04	0.66	-0.62
Root Cause Analysis	0.04	0	0.04
Procedure not followed	0	16.39	-16.39
Total	100	100	0

Pearson chi2 = 404.1969 (Pr = 0.000)

Likelihood-ratio chi2= 233.2203 (Pr = 0.000)

3.1.21. Active Dissemination of Events

Table 3-21 compares near miss and injury proportions found in each subcategory of Active Dissemination of Events. The small differences in proportions among the Active Dissemination of Events subcategories indicate that near misses and injuries proportions may be similar.

Table 3-21: Comparison of Near Miss Proportion to Injury Proportion by Active Dissemination of Events

Active Dissemination of Events	Near Miss (%)	Injury (%)	Difference (%)
Ship and Similar Ships	90.01	89.18	0.83
Fleet	5.23	9.18	-3.95
Unspecified	4.67	0.98	3.69
None	0.08	0.66	-0.58
Ship Level	0	0	0
Total	100.0	100	-0.01

Pearson chi2 = 21.9454 (Pr = 0.000)

Likelihood-ratio chi2 = 22.1418 (Pr = 0.000)

3.1.22. Negative Consequences towards Employees

Table 3-22 compares near miss and injury proportions found in each subcategory of Negative Consequences towards Employees. The differences in proportions among the Negative Consequences towards Employees subcategories indicate that near misses and injuries proportions are not similar across all categories of Incident Triggers.

Table 3-22: Comparison of Near Miss Proportion to Injury Proportion by Negative Consequences towards Employees

Negative Consequences towards employees	Near Miss (%)	Injury (%)	Difference (%)
Yes	74.37	58.03	16.34
No	2.85	22.3	-19.45
Unspecified	22.78	19.67	3.11
Total	100	100	0

Pearson chi2 = 212.1652 (Pr = 0.000)

Likelihood-ratio chi2= 135.4254 (Pr = 0.000)

4. CONCLUSION

We carried out a study analyzing the patterns of near miss and injury proportions among specific subcategories of crane related incidents occurring in a maritime company. It has been aimed to determine if the analysis of near miss reports can be used to predict crane related injury incident occurrence. From our analysis, we found that near misses and injuries do not follow the same pattern for the majority of are categories examined in this study. Only the Cause of Incident category had similar patterns for near miss and injury incidents. This study indicates that while near misses may be able to predict broader causes of injury incidents such as human error or faults in crane equipment, it does not accurately predict specific causes of injury such as operator error, inattention, failure of lifting equipment. Also, while the analysis of near miss reports was able to predict a few of the major subcategories (Struck by and Falling objects in the Type of Event category) under each category, they were not able to pick up all the major subcategories for injury (Slips and Trips). Therefore, while near misses may still be of use in identifying some of the causes of injuries, we suggest that near misses that caution be taken while utilizing near misses in the prediction of injury incidents. This is because analysis of near misses may miss some important factor associated with the development of injury incidents.

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