

**ORIGINAL RESEARCH ARTICLE****Determinants of effective control of accidents in the port of Mombasa, Kenya.*****Nahashon Manyara Kiogora¹, Robert Kinyua², Margaret Gichuhi³****¹KEMRI-Wellcome Trust Research Programme, Operations HSE department, Kenya.**²Department of Physics, Jomo Kenyatta University of Agriculture and Technology, Kenya.**³Institute of Energy & Environmental Technology, Jomo Kenyatta University of Agriculture and Technology, Kenya.*Corresponding email: nmanyara@kemri-wellcome.org**ABSTRACT**

Mombasa port plays a pivotal role in the economic development of East and Central African countries where goods of varying hazards transit the port. The risk of serious accidents is inevitable due dangerous operations involving cranes and handling of hazardous materials. Ports are potential sources of accidents such as spills, explosions, fires, toxic fumes The goal of this study was to evaluate determinants of effective control of accidents in the port of Mombasa. The study employed a descriptive survey research design where structured questionnaires were used to collect data. Random sampling was used to identify 248 study participants from a population of 650 workers. Data was analyzed using SPSS version 20 at 95% confidence interval. Data was subjected to descriptive tests to determine proportions as well as chi square test and presented using graphs and tables. The rates of occupational accidents in Mombasa port were significantly high with 99.5% of the port workers reporting to have witnessed occurrence of accidents. Accidents reported by port workers include crane failure, chemical spillage, fire accidents and explosions. The main container terminal had recorded the highest number of occupational accidents compared to other terminals. There was a significant association between training on accident hazards and improvement on understanding of accident prevention ($X^2 = 0.029$ $P = 0.05$ $DF = 1$). study reveal that training on accident would help reduce occurrence. The determinants of effective control of accidents in the port of Mombasa that were studied included: Safe sytems of work, risk assessment, cargo handling equipment and training.

Key words: Cargo handling equipment, major accident hazard, risk assessment, safe systems of work

1.0 Introduction

The relatively low frequency of reported major accidents resulting from port operations can lead to inadequate attention being paid to systems and controls to reduce the risk of occupational accidents in the ports. The potential for accidents to happen in ports has increased in the recent past due to an increase in trade volumes where approximately 50% of goods carried by sea and handled in ports are classified as hazardous and, if wrongly handled, could cause the death of people, environmental disaster, or destruction of property. The overall objective of this research was to evaluate determinants of effective control of major

accidents in the port of Mombasa. Most maritime accidents related to dangerous cargo happen in ports and harbors (IMO, 1998). Ports are often challenging places to work in terms of hazards present in various undertakings, especially transport and handling of harmful cargoes, which qualified ports to be regarded as the second most dangerous industry after the nuclear power industry (Tarmo, 2000). Thus, the potential for major accidents to happen in ports has increased due to an increase in trade volumes globally, but only a few studies have tackled the critical issue of determinants to their effective control (Mejia et al., 2010).

The multiple causation theory by Burn and David (2006) holds that major accidents in ports can arise from either behavioral (about the worker's improper attitude, lack of knowledge and skills) or environmental (about improper guarding of hazardous work elements and degradation of equipment through use and unsafe procedures) aspects. For example, a company facing financial challenges may be postponing preventive maintenance of key cargo handling equipment and machines or foregoing key training of its staff, who may be taking shortcuts on operating procedures and using suspect materials and riskier technology (Roberson, 2004). The Occupational Safety and Health (Dock Work) Convention (No. 152), 1979 Article 38, Paragraph 1 states "no worker shall be employed in dock work unless he has been given adequate instruction or training as to the potential risks attached to his work and the main precautions to be taken", ILO Code of Practice on Safety and Health in Ports (ILO, 2003). In Kenya, the OSHA 2007 has subsidiary legislation called the Occupational Safety and Health (Docks) Rules, 1962, which applies to workplaces where there is loading, unloading, moving, and handling goods in or on a dry or wet dock, wharf, or quay, port, or harbor. The rules stipulate various safety provisions required to ensure the safety of workers in the port.

According to the International Chamber of Shipping (2013), there is a great risk of a major hazard accident arising in port operations because of the transport and handling in the ports of a hazardous substance in bulk. Hence, most accidents can be avoided if the risks from the work are suitably and sufficiently assessed and appropriate control methods are adopted. Ports should have plans for dealing with emergencies that could have a wider impact, and the plans should be based on risk assessments (Corson et al., 2008). This is because the growing move towards heavier lifting operations in ports is one trend that seems universally tipped to continue.

A survey carried out by the World Bank on Least Developed Country (LDC) ports (World Bank technical paper, 1990) revealed that many LDC ports have poorly educated and ill-trained equipment operators who lack well-conceived and clearly understood operating procedures backed up by careful recruitment, selection, and training. The lack of such procedures often encourages and subsequently legitimizes routine violations and short-cuts. Such violations are often quoted as one of the most common root causes of major accidents within and outside of ports. As Kilvington (2004) holds the view that where written procedures are not in regular use, as is the case for the bulk of the work carried out within many ports, there would be an implicit assumption that the skills and knowledge embedded in the procedure have been provided in initial training and are regularly maintained via appropriate refresher training.

Whether a port is large or small, it has a large investment in mechanical equipment and infrastructure that needs to be maintained and protected. A study carried out by Ilchenko (2012) found that equipment and machinery failure was the third most common reason for major accidents in ports, after contact damage and collisions. If not reported in due time and not addressed immediately, defective equipment will result in major accidents and property damage. The survey conducted by the World Bank found out that many less developed countries (LDCs) are experiencing serious port cargo handling equipment maintenance problems and, worse, that these problems are steadily increasing as their ports struggle to acquire and manage the more complex cargo-handling equipment needed to respond to the port stakeholder's demands (World Bank technical paper, 1990).

2.0 Materials and Methods

The study was guided by four specific objectives, namely, to assess the effectiveness of safe work systems implemented towards control of major accidents; to examine cargo handling equipment maintenance and repair systems in place towards ensuring effective control of major accidents; to identify training needs gaps towards enhancing effective control of major accidents; and to assess the current risk management process in place towards effective control of major accidents.

2.1 Study site

The study was conducted at the Port of Mombasa, Kenya's biggest port and one of the busiest ports in East Africa. The port is considered the main entrance port to the larger East Africa and serves millions of people in the hinterland and the landlocked countries and sections like Uganda, Rwanda, Ethiopia, Burundi, and the Democratic Republic of Congo. Due to this strategic location, the demand for Mombasa port has been increasing over recent years. This port is managed by the Kenya Ports Authority under the ministry of roads, transport and infrastructure development, which has taken steps to increase modernization of the various infrastructure used in the port.

2.2 Study design

The study adopted a descriptive survey research design where collection of data was conducted through interviews, questionnaires, and observation checklists. The research participants were drawn from management dock workers' union staff, employees, and contractors.

2.3 Target population

The target population for this study was 650 drawn from various departments

2.4 Sample size determination

A sample size of 248 was computed using Slovin's formula and random sampling was used to identify the study participants.

$$n = \frac{N}{1 + N(e)^2}$$

Where:

n = Number of samples

N = Total population

e = Error tolerance/margin of error

$$247.6 = \frac{650}{(1+650(0.05)^2)}$$

The sample size, as determined above, was 248.

This study design helped in evaluating the determinants of effective control of major accidents in the port of Mombasa.

2.5 Data collection

Validation of the data collection instrument was done at the Mombasa Container Terminal depot, where four sample questionnaires were piloted. Data was collected using a structured questionnaire. The questionnaires were administered by trained research assistants in the study area. The researcher also conducted interviews with randomly selected respondents from the targeted departments. Additional information was collected using a hazard observation checklist during the process of data collection. Permission to conduct the study was sought from the office of the Managing Director, Kenya Ports Authority and the Mombasa port management, Ethical approval of the proposal was given by the Pwani University Ethical Review Committee. Additionally, informed consent was sought from the study participants.

2.6 Data analysis and presentation

The data was cleaned and entered into SPSS version 20. A descriptive analysis was done to show the proportions of accidents and injuries at Mombasa port. Chi-square tests were also done to identify factors associated with the occurrence of accidents at the port of Mombasa. Data analysis was done at a 95% confidence interval. Tables and graphs were used to present the information generated from the data analysis process. The study used descriptive statistics to show distribution, relationships between variables under study and proportions in terms of percentage interpretation.

3.0 Results

The target sample size was 248 out of which 206 took part in the study equivalent to 83% response rate.

3.1 Demographics

A number of respondents, 48.5% were from the operations department majority of whom were dock workers spread across the container terminal, as well as the contractor staff.

Table 1: Distribution of respondents by department

Department	N	Percent
Operations	100	48.5
HR and Administration	13	6.3
Technical services	29	14.1
Infrastructure/projects	48	23.3
legal services	16	7.8

Results showed that there were more male respondents (77.2%) compared to female respondents (22.8%) and that the majority of respondents were above thirty years of age and had studied up to the level of a diploma in their education, as shown in table 2 below.

Table 2: Socio demographic characteristics of KPA employees in Mombasa port

Variable	Frequency	Percentage (%)
Gender		
Male	159	77.2
Female	47	22.8
Age		
21 - 30 years	30	14.6
31-40 years	69	33.5
41-50 years	86	41.7
over 50 years	21	10.2
Level of education		
primary	29	14.1
secondary	57	27.7
Diploma	88	42.7
Degree	32	15.5
Job cadre		
Operations	103	50.0
HR and Administration	12	5.8
Technical services	31	15.0
Infrastructure/projects	45	21.8
legal services	15	7.3

As shown in the chart below, the majority of the respondents had worked for the organization for more than ten years.

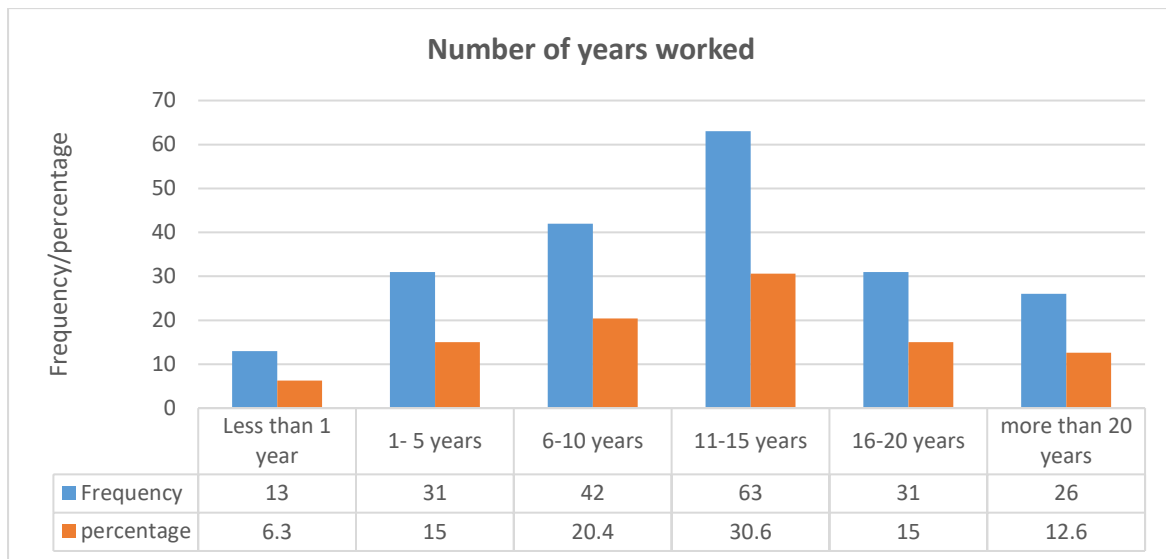


Fig 1: Years of work experience of the respondents

The majority of employees reported having witnessed fire accidents (76.3%) while only 23.3% reported not having witnessed fire accidents, as shown in Table 3 below.

Table 3: reported Accidents at Mombasa port

Nature of accidents	Yes (%)	No (%)
Fire accidents	76.3	23.3
Explosions	50	50
Chemical spillage	91.7	8.3
Crane failure	97.1	2.9

Half of the respondents reported that they had witnessed explosion accidents at the port. The majority of the employees had witnessed accidents in the form of chemical spillage and crane failures (91.7% and 97.1% respectively) and only a small proportion indicated that they had not witnessed the two accidents (8.3% and 2.9%) respectively.

3.2 Safe systems of work factors associated with occurrence of accidents at Mombasa port

The port was found to be a multi-stakeholder operations site with 20% of employees being contractors. The two safe systems that were used to control contractors were the permit to work system and the contractor management system (access control). However, these two systems were lowly rated by respondents who held the view that the contractor management system and permit to work would have less effect compared to the use of operation procedure and emergency response systems in the control of major accidents in the port, as shown in the chart below.

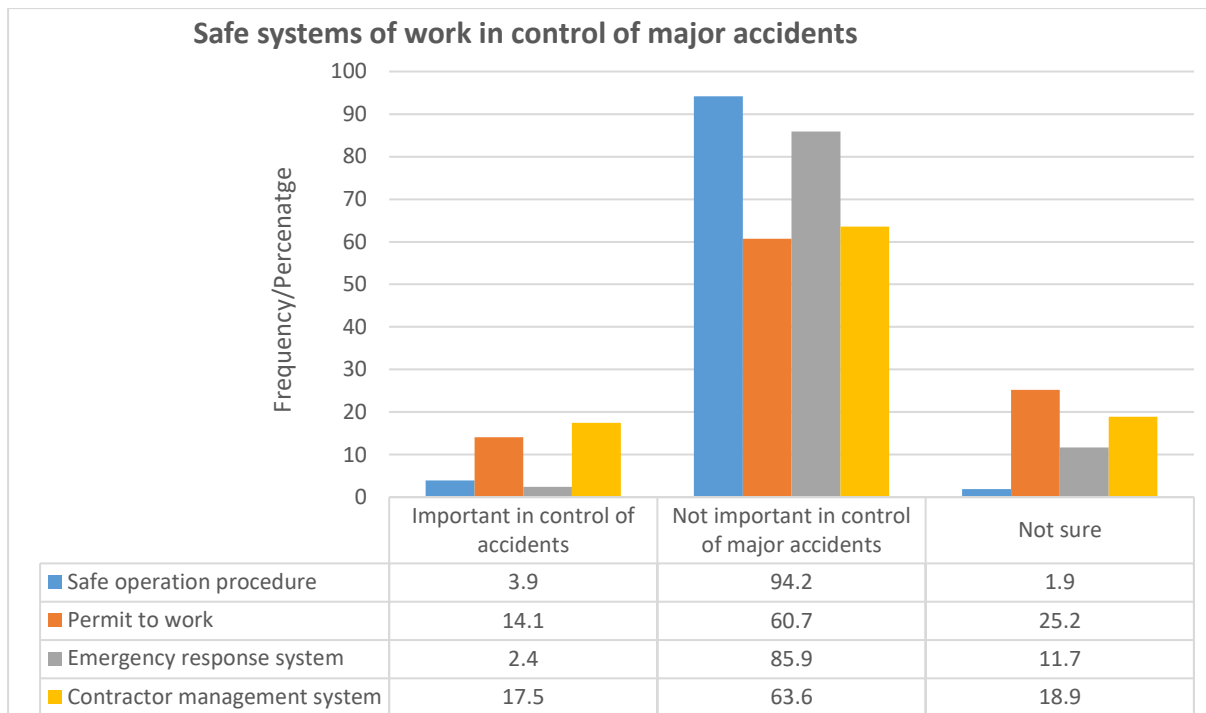


Fig 2: Importance of safe systems of work

A high proportion of respondents, 94.2%, held the view that safe operations procedures would not help in the control of major accidents in the port. This could mean that there is deep-seated poor safety culture behavior and that sometimes the procedures would be disregarded to get the job done.

Results showed that only the permit to work system responses had significant variation from the mean (Sig = 0.074 > p = 0.05, DF = 3 at 95%). As shown below, there was no significant variation from the mean for safe operation procedures (Sig = 0.0302P = 0.05, DF =3), emergency response system (Sig = 0.013P = 0.05, DF =3), and contractor management system (Sig = 0.034P = 0.05, DF =3). This meant that the permit to work safe system would not be very effective in control of major accidents.

Table 4: ANOVA for responses of different safe systems versus control of accidents

Safe systems critical in control of major accident	DF	Mean squares	F	Sig
Safe operation procedures	3	0.334	1.204	0.032
Permit to work system	3	0.226	0.291	0.074
Emergency response system	3	1.149	2.016	0.013
Contractor management system	3	0.98	2.640	0.034

The issue of contractor management and associated safety systems like safe port operation procedures were not well entrenched in the port as some of the respondents disapproved of

them as being ineffective in controlling major accidents. This disapproval also points to entrenched negative perceptions leveled against third parties operating in the port. The disapproval of safety procedures by 94.2% of respondents as not important towards the control of major accidents could mean unsafe behavior such as shortcutting is rampant.

3.3 Cargo handling equipment factors associated with occurrence of accidents at Mombasa port

Cargo handling equipment at the port included: cranes (rubber-tired gantry or rail mounted gantry), container handlers (top picks and side picks), forklifts (mostly by contractors), and bulk handling equipment (tractors, loaders). Respondents reported having witnessed various major accident occurrences such as fire and spillage that were related to cargo handling equipment, as shown in the chart below.

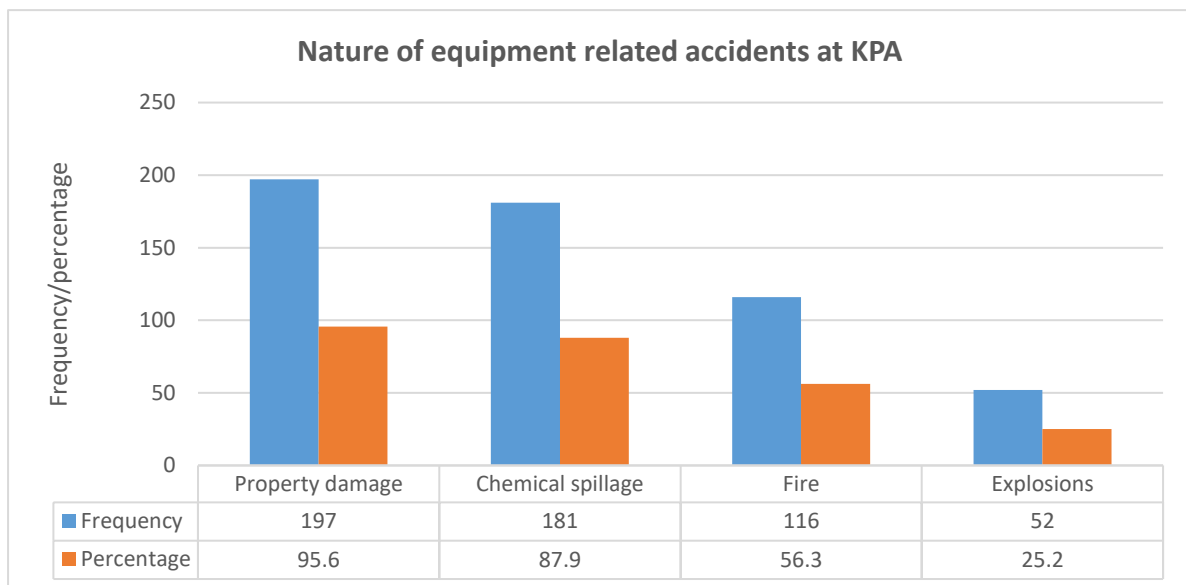


Fig 3: Accidents at Mombasa port

A Pearson’s chi-squared test of association was done at a P-value = 0.05 to establish whether there was any significant association between inadequate/poor equipment maintenance and the various equipment-related nature of accidents: fire, explosion, chemical spillage, and property damage, cited by respondents at KPA as shown below. Since $P = 0.031$, $P = 0.039$, $P = 0.027$, and $P = 0.016 \leq \alpha = 0.05$ at 95% confidence interval, it means that there is a statistically significant association between poor maintenance of equipment and the likelihood of leading to a major accident of either fire, explosion, chemical spillage, or crane failure and property damage, as shown below.

Table 5: Association of equipment maintenance versus fire accident

	Value	df	Asymptotic Significance (2-sided)
Pearson Chi-Square	3.865 ^a	4	.042
Likelihood Ratio	3.537	4	.044
Linear-by-Linear Association	1.027	1	.031
N of Valid Cases	206		

Table 6: Association of equipment maintenance versus explosion accident

	Value	df	Asymptotic Significance (2-sided)
Pearson Chi-Square	6.518 ^a	4	.016
Likelihood Ratio	6.702	4	.015
Linear-by-Linear Association	.717	1	.039
N of Valid Cases	206		

Table 7: Association of equipment maintenance versus chemical spillage accident

	Value	df	Asymptotic Significance (2-sided)
Pearson Chi-Square	6.610 ^a	4	.015
Likelihood Ratio	5.067	4	.028
Linear-by-Linear Association	.124	1	.027
N of Valid Cases	206		

Table 8: Association of equipment maintenance versus crane failure accident

	Value	df	Asymptotic Significance (2-sided)
Pearson Chi-Square	2.220 ^a	8	.019
Likelihood Ratio	3.463	8	.029
Linear-by-Linear Association	.210	1	.016
N of Valid Cases	206		

The total number of accidents for the period of October to December 2017 was found to be 139. Container terminals had the highest number of accidents at 88 compared to conventional terminals, which had 51. Less accidents at the conventional terminal would probably be because of less equipment being used and less traffic compared to the container terminal. and private trucks operated by contractors collide with packed containers.

Table 9: Training related factors associated with occurrence of accidents at Mombasa port

Variable	Witnessed occurrence of accidents		P value
	Yes F (%)	No F (%)	
Training on accident awareness			
Improved	110(53.4)	1(0.5)	0.354
Not improved	95(46.1)	0(0)	
Duration of training			
None	95(46.1)	0(0)	0.207
< 8 hours	62(30.1)	0(0)	
1 day	29(14.1)	1(0.5)	
1 week	18(8.7)	0(0)	
>1 week	1(0.5)	0(0)	
Training facilitator			
None	97(47.1)	0(0)	0.036
Internal	82(39.8)	0(0)	
External	26(12.6)	1(0.5)	
Accident knowledge after training			
Above average	13(6.3)	0(0)	0.294
Average	59(28.6)	1(0.5)	
Poor	133(64.6)	0(0)	
Training of staff on major accident management			
Important	199(96.6)	0(0)	<0.001
Not important	6(2.9)	1(0.5)	
Contractor training on accident prevention			
Important	167(81.1)	0(0)	0.038
Not important	38(18.4)	1(0.5)	
Ability to respond appropriately to accidents			
Can respond	35(17.0)	1(0.5)	0.029
Can't respond	169(82)	0(0)	

As shown in the chart below, it was found out that the number of those who had not been trained on major accidents was high compared to those who had been trained.



Fig 4: Responses on number of respondents trained on accidents at KPA

There was a significant association between training on major accident hazards and improvement in understanding of major accident prevention ($\chi^2 = 0.029, P = 0.05, DF = 1$). This could mean that training on major accidents would help in increasing employees' understanding and response to major accident events, which was found to be lacking at the time of the research.

Table 10: Association between training and accidents prevention

	Value	df	Asymp. Sig. (2-sided)
Pearson Chi-Square	135.851 ^a	8	.000
Likelihood Ratio	163.649	8	.000
Linear-by-Linear Association	4.791	1	.029
N of Valid Cases	206		

Contractor staff interviewed on site confirmed that they had neither received any form of training on accident prevention in the ports from their employers nor from the KPA, contrary to the requirement of OSH Act 2007 section 17 (1–4) that requires the provision of information and training for non-employees of the occupier. Lack of tight control on contractors might lead to the operation of machines by incompetent people, increasing the chances of the occurrence of a major accident. Training was not standardized and offered to both employees and contractors to raise the risk perception levels regarding major accident occurrences in the ports.

The majority (96.6%) of the KPA employees who had witnessed accident occurrences at the port perceived training on major accident management as important. Only 2.9% of the participants having witnessed the occurrence of accidents reported that training was not important. There was a significant association between contractor training on accident prevention and the occurrence of accidents at Mombasa port ($p = 0.038$). The majority (81.1%) of the KPA employees who had witnessed accidents reported that contractor training was

important. The remaining proportion (18.4%) termed this training as not important. Only 0.5% of respondents reported not having witnessed the occurrence of accidents and reported that contractor training was important. There was a significant association ($p = 0.029$) between the ability to respond appropriately to accidents and the occurrence of accidents at the port. More than three quarters (82%) of the KPA employees who witnessed accidents cited that they had no ability to respond to accidents appropriately. Only 17.5% of the participants reported having the ability to respond appropriately to accidents. The following factors were not found to have a statistically significant association with the occurrence of accidents at Mombasa port: training on accident awareness ($p = 0.354$), duration of training ($p = 0.207$), and accident knowledge after training ($p = 0.294$).

3.4 Risk assessment Process factors associated with occurrence of accidents at Mombasa port

The risk assessment framework in place was found to be one where risk assessment was carried out by the safety department or line managers without involving or consulting other employees, especially the operators, who do the job.

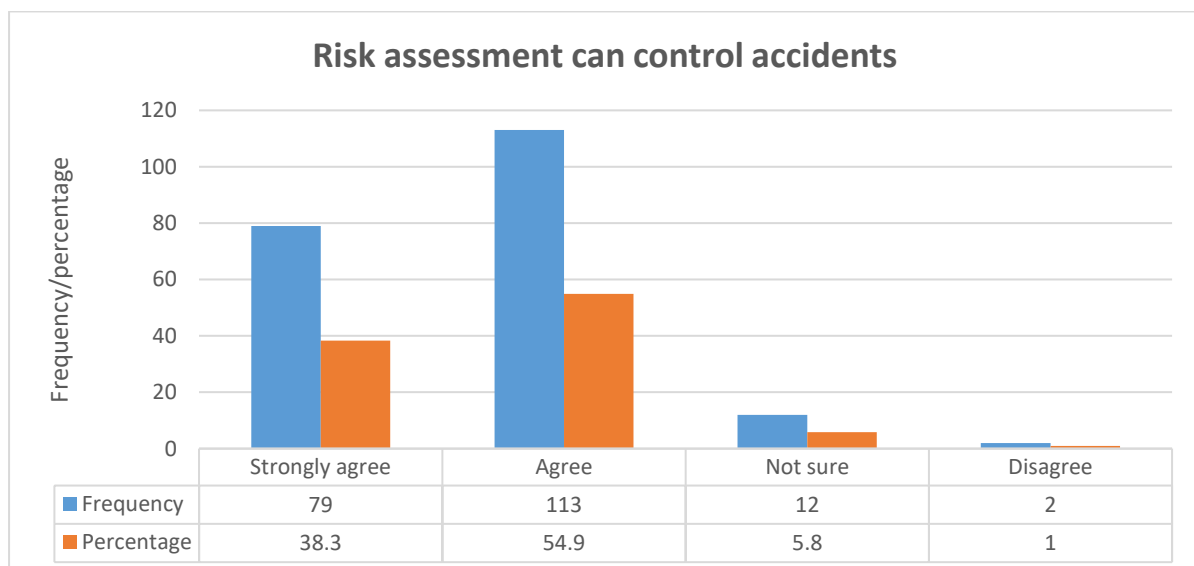


Fig 5: Importance of risk assessment in control of accidents at KPA

The finding that a majority of 93.2% were of the view that risk assessment of hazardous installations would help in the prevention of major accident hazards showed that respondents held the view that risk assessment, if done thoroughly and extensively for all the port operations and the recommendations implemented as required, would help in the effective control of major accidents in the operations. But they would need to be involved to appreciate the importance of risk assessment in the control of major accidents. It was noted that the respondents held the view that use of risk assessment as a way of approving contractors operating in the port and approving hazardous installations in the port would help to control major accidents in the port if well implemented and sustained.

A total of ten pieces of cargo handling equipment were sampled during the day shift. Equipment sampled included rubber-tired gantry cranes, straddle carriers, forklifts, and reach stackers. Although no photos were allowed to be taken, it was found that all of the equipment for the KPA was inspected, contained inspection stickers, and was found to have been enrolled in a preventive maintenance program. Most of the equipment in use by the contractors were the forklift trucks, of which three were found not to have been inspected while the rest had expired inspection stickers. None were under a preventive maintenance schedule. The equipment inspected and its status are shown in the table below.

Table 11: Inspection status of equipment sampled at KPA

Equipment	KPA	Contractor	Inspected
Rubber tired gantry crane	2		Yes
Straddle carrier	1		Yes
Reach stacker	2		Yes
Forklift		5	No

4.0 Discussion

In this study, a significantly high number of workers have reported that they have witnessed the occurrence of major accidents at the port. Furthermore, the main accidents witnessed at Mombasa port were crane failure, chemical spillage, fire, and explosions. These findings compared very closely with those of a study done by Tsenga and Nick (2017) on "Causes of major accidents in Kaohsiung Port in Taiwan". According to this study, fire, explosion, and equipment (crane) failure accounted for close to 30% of the total major accidents analyzed from the years 2010 to 2014. There were found to be ineffective safe systems of work that were poorly implemented and some cargo handling equipment in use at the port that was not under any preventive maintenance plan. In addition, some gaps in training were identified and the risk management process in place was found to be isolated where operators were not involved in any way. No policy or regulation dealing specifically with the control of major accidents in the ports was implemented.

The safe systems found in use were access control, permits to work, and shift handover notes. Control of entry of third parties into the port was mainly done by the use of access control only, as opposed to risk assessment of their jobs and permits to work. There was a poor contractor management system in the port in that the control of contractor activities in the port as one of the safe systems of work was not well entrenched, to the extent that the contractor activities and operations were neither regulated nor closely monitored to avoid the occurrence of major accidents. There was no system of ensuring contractor compliance once they were inside the port and working on different projects. The safe operation procedure as well as other safe systems of work like the PTW were not enhanced to the extent of improving compliance and minimizing major accident occurrences. These results confirmed the findings of a study done by Ilchenko, Y. (2012) on Port State Control where he studied control of contractors in the port area and found out that the levels of compliance management of different port contractors in Malaysia were different. There was no standardized way to



ensure compliance by all contractors that was applied uniformly across the port, and this could create gaps and ultimately lead to the occurrence of occupational accidents in the port. The results were also compared closely with the study done by Helal H.M. (2009), who studied Safety and Security around the Egyptian Coasts (Security and Safety in Short Sea Shipping Operations) and found out that the contractor management system of using the Permit To Work (PTW) system was not adhered to and applied to all the contractors in the port.

Cargo handling equipment was found to be the largest contributor to accidents occurring in the port by way of fatalities, spillages and property damage. There was no preventive maintenance schedule for the equipment used by the contractors on site. In addition, some equipment in operation by the contractors and port staff was found to be overdue for service and maintenance. Others were not enrolled in any repair and maintenance schedule, as discovered through the checklist and during the interview, although they were under operation. Poor equipment maintenance, exceeding the safe working load, a standardized replacement policy for equipment, and insufficient funding for equipment maintenance were all found to be significantly associated with the occurrence of occupational accidents in this study. These findings compared closely with the findings of the research by Larry et al. (2007) on "Crane Accidents and Emergencies—Causes, Repairs, and Prevention". They found out that a significant percentage of major accidents in the port are attributable to cargo handling equipment and that 53% of accidents occurred in container terminals. Ideally, it is expected that in order to prevent occupational accidents, machines need to be properly maintained, there should be adequate funding to ensure continuous improvement, standard operating procedures need to be adhered to, and there should be a supportive regulatory framework. Through observation and maintenance records review, there was no clear documentation on equipment preventive maintenance or statutory inspection schedule for equipment used by contractors. This showed that cargo handling equipment maintenance and repair systems were not well enforced. It was also found out that there was no enforced national regulation guiding control of major accidents in the ports or a major accident prevention policy in place that would help in enforcement of control of the occurrence of major accidents in the ports. Although the majority of the respondents had worked for the company for more than ten years, some had not received any form of training on the control of major accidents, as only 46.1% of the respondents had been trained in other areas like first aid awareness. The results of this study cited a significant association between the type of trainer and the occurrence of occupational accidents whereby port workers reported that lower rates of accidents were witnessed when training was done by an external facilitator. This could potentially be attributed to the fact that external trainers are more experienced, are objective, and are not prone to any biases. For those who had been trained, they did not feel that the training offered them the required competency and confidence to respond to an emergency arising from the occurrence of a major accident. This could mean that the training did not have the required impact either because of the relevance of the content covered, the duration of training, or the competency of the facilitators in covering topics in major accident prevention. Furthermore, there emerged a general perception that the training of contractors was not as important as that of Kenya Ports Authority employees, even if they worked in the same environment and

the consequences of a major accident would not discriminate between the two groups. The findings are similar to those of a study done by Froese, J. (2006) in Germany on effective operations in ports, where it was concluded that a lack of training programs on major accidents contributed to the occurrence of major accidents. In addition, the findings on training compare with those of the study by Abd El-al, H. M. and Shaheen, A. (2009). They studied "The risk assessment and effect on improving the productivity in Egyptian container terminals" and found out that the accident awareness was improved after training of the workers and would help in case of emergencies such as accidents in the port.

It was discovered that risk assessments were conducted by line managers and the safety department without involving the operators who did the job, implying that the operators were not empowered to conduct adequate and appropriate risk assessments whenever they engaged in any activity or operation in the port. This finding confirmed the finding of a study done by DET NORSKE VERITAS (2012), where it was concluded that managing risk in a workplace set up requires a consultative process involving all stakeholders, especially those who actually do the job, like the contractors, through a risk assessment process so that they can fully understand what the job entails, the risks inherent in it and the mitigation for each of the risks identified. In addition, Kilvington, R. (2004), in a study titled "Port and Harbour Risk Assessment and Safety Management in New Zealand," concluded that risk assessment helps in awareness of hazards in the port areas. This was a gap compared with the finding of this study that there was no standardized method that was known by all staff for reviewing or updating the risk assessment to ensure changes in risks had been mitigated. The recommendations and proposed actions from the risk assessment were not implemented to the extent recommended because of the bureaucratic approval process and low allocation of resources. This may lead to delays in conducting repairs and maintenance, thereby creating an opportunity for the occurrence of a major accident.

5.0 Conclusion

The number of witnessed cases of occupational accidents in Mombasa port was significantly high. Major accidents in the port were found to be caused by crane failure, chemical spillage, fire, and explosions. Training-related factors were found to have a significant association with the occurrence of occupational accidents in the port of Mombasa. Additionally, cargo facility-related factors cited to have a significant association with the occurrence of occupational accidents at Mombasa port were poor equipment maintenance, exceeding of safe working load, lack of equipment standardized replacement policy and inadequate funding towards equipment maintenance.

6.0 Acknowledgements

6.1 Funding

None

6.2 Analysis and Research

The analysis and research were conducted at the Institute of Energy and Environmental Technology (IET) at Jomo Kenyatta University of Agriculture and Technology.

6.3 Declaration of interest

The author declares that they have no conflict of interest. The manuscript studies were organized in a chosen manner based on their relevance to the subject matter and predicted work quality, rather than being exhaustive in fulfillment of the requirements for obtaining an "MSc in Occupational Safety & Health".

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