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Causes and Impact of Port Accident on Operational Performance of Nigerian Seaport at Tin Can Island, Lagos Nigeria

OKPARA, AR; ANYANWU, OJ; DIRISU, AI; OKOREFE, OC

Faculty of Transport, Nigeria Maritime University, Okerenkoko, Warri, Delta State

**Corresponding Author Email: okey_good2002@yahoo.com*
**ORCID ID: https://orcid.org/0000-0002-3621-1470*
***Tel:** +2348036608592*

Co-Authors Email: ruthokpara@gmail.com; dirisuanthony156@gmail.com; twindeck638@yahoo.com

ABSTRACT: The objective of this paper is to identify the causes and impact of port/harbor accident on operational performance at Tin Can Island, Lagos, Nigeria using appropriate standard methods to obtain primary and secondary data from reliable sources by distributing 80 questionnaires. Data obtained show that the major causes of accident include; over capacity usage, failure to consider dangerous goods' separation and coordination deficiency by management. The study's findings indicate that, based on the survey data that was collected and the testing of each listed hypotheses, all of the hypotheses were found to be significant, this relationship can be seen in the ANOVA table where the significance value of the F statistics is greater than 0.05 which means the variation explained by the model is due to chance. It was recommended that seaports should regulatory bodies and port operators should enforce safety regulations and provide adequate training and safety measures to prevent accidents and improve the safety and efficiency of port operations.

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The growth and performance of a port is vital in any nation and as such cannot be over emphasized. A port is a seafaring facility comprising one or more quays or loading areas, where ships load and discharge freight and passengers, The term accident implies that nobody should be blamed, but the event may have been caused by unrecognized or unaddressed risk, (Wikipedia 2022). Port performance is a function operational and financial performance indicator, (Qureshi, 2007). Operational indicators are; Arrival late (ship/day), waiting time (hour/ship), service time (hour/ship), turnaround time (hour/ship), fraction of time berth ship worked, number of gangs employed by ship per shift, ton per ship-hour in port, ton per ship-hour at berth, ton per gang-hour, fractions of time gang idle, (Adewole and Abiola, 2020). Nigeria has an aggregate of eleven ports and eight oil terminals sifted through in three zones of Western, Central and Eastern Zones. The Central Zone with its Headquarters in Warri, the Western Zones with Headquarters in Lagos and the Eastern Zone with its Headquarters in Port Harcourt are dominatingly oil terminals (Nigerian Ports Authority, 2022) and Maritime Injury Guide 2022). The performance of a port is important as most of the cargoes transported are moved through the seaport, (Adegbite, *et al,* 2020). Any obstruction during these operations can affect the economy, and as such all-port operations carried out in the port must be done with circumspection, guardedness, and most

**Corresponding Author Email: okey_good2002@yahoo.com*
**ORCID ID: https://orcid.org/0000-0002-3621-1470*
***Tel:** +2348036608592*

importantly operations should be carried out by well trained and skilled staff, (Oluwole, and Akintoye, 2019). Also, the effect of accidents cannot be overemphasized as it affects port performance and port operations are obstructed by accidents which reduces the performance of the port drastically, (Awal and Hasegawa, 2015) and (Oluwole and Akintoye, 2019). Take for example, the occurrence of accident during discharge of cargo caused by failure of cargo handling equipment, this eventually will affects the service time of the vessel as well as the waiting time of other vessel waiting to berth, which in turn affects the turnaround time of the vessel, the fraction of time berth ship worked, number of employees number of gangs employed by ship, ship hour at port, ton per hour at berth, ton per gang-hour, and fractions of time gang idle, Dayananda, *et al.* (2018) and ((Gul,2016). Hence, the objective of this paper is to identify the causes and impact of port/harbor accident on operational performance at Tin Can Island, Lagos, Nigeria.

MATERALS AND METHODS

Research design adopted in this research is survey research. The targeted population for this study was 80 (eighty) and consist of employees and operators at the port and harbor area. This study is quantitative and qualitative in nature. The sample consists of employees of the seaport to elicit information on the level and causes of port accidents. The study also used port performance indicators such as: cargo throughput, ship traffic, turnaround time, berth occupancy at the port as performance dependent variables. Simple random sampling technique was used to select the respondents for the study. The Taro Yamene sample size determination formula for finite population was used in determining the (eighty samples) sample size for this study from the population of one hundred staff from the safety department of the seaport. The hypotheses formulated was analyzed using multiple regression analyses through the instrumentality of a statistical package for social and statistical scientist (SPSS).

RESULTS AND DISCUSSIONS

Questionnaire Response Rate: Descriptive statistics such as frequencies and percentages have been used to analyze responses to a variety of objects in the questionnaire. The research survey resulted in a response rate of 94% in the place by way of 75 out of the 80 respondents in the goal populace replied to the questionnaires administered to them. The result from table .2 shows the result of gender respondents 70.7% are male while 29.3% are female, which shows that there was gender no biasness.

Table: 1. Respondent Rate

Response Rate	Frequency	%
Responded	75	94%
Not Responded	5	6%
Total	**80**	**100**

***S**ource: Research survey 2024.*

Table .2. *Gender of Respondents*

Gender	Frequency	%	Valid %	Cumulative %
Male	53	70.7	70.7	70.7
Female	22	29.3	29.3	100.0
Total	**75**	**100.0**	**100.0**	

Source: Research Survey, 2024.

Table .3: Age of Respondents

Age	Frequency	%	Valid %	Cumulative %
17-25	5	6.7	6.7	6.7
26-35	28	37.3	37.3	44.0
36-45	30	40.0	40.0	84.0
46 above	12	16.0	16.0	100.0
Total	**75**	**100.0**	**100.0**	

Source: Research Survey, 2024.

Table: 5. Educational qualification respondents

Qualification	Frequency	%	Valid %	Cumulative %
Primary	8	10.7	10.7	10.7
Secondary	33	44.0	44.0	54.7
Tertiary	23	30.7	30.7	85.3
None	11	14.7	14.7	100.0
Total	**75**	**100.0**	**100.0**	

Source: Research Survey, 2024.

Table: 6. Marital Status

Status	Frequency	%	Valid %	Cumulative %
Married	34	45.3	45.3	45.3
Single	30	40.0	40.0	85.3
Widower	5	6.7	6.7	100.0
Total	**75**	**100.0**	**100.0**	

Source: Research Survey, 2024

Table: 7. Occupation

Departments	Frequency	%	Valid %	Cumulative %
Stevedore	17	22.7	22.7	22.7
Terminal operators	39	52.0	52.0	74.7
longshoremen	12	16.0	16.0	90.0
Clerical	6	8.0	8.0	98.7
Others	1	1.3	1.3	100.0
Total	**75**	**100.0**	**100.0**	

Source: Research Survey, 2024.

Table 8. Experience

Working experience					
		Frequency	%	Valid %	Cumulative %
Valid	0- 12 months	1	1.3	1.3	1.3
	1-2yrs	1	1.3	1.3	2.7
	3-5yrs	16	21.3	21.3	24.0
	5-7yrs	42	56.0	56.0	80.0
	above 7yrs	15	20.0	20.0	100.0
	Total	75	100.0	100.0	

Source: Research Survey, 2024

Table 9: Major causes of harbour accident

ITEM	Options	Strongly Disagree	Disagree	Neutral	Agree	Strongly Disagree	Total
1	Level of training & experience contribute to the occurrence of harbour accident	0	1 1.3%	23 30.7%	41 54.7%	10 13.3%	100
2	Fatigue has played a role in the occurrence of harbour accident	0	3 4.0%	35 46.7%	36 48.0%	1 1.3%	100
3	Unconscious behaviour plays a role in the occurrence of harbour accident	0	0	20 26.7%	43 57.3%	12 16.0%	100
4	Ignorance/negligence/lack of attention plays a vital role in the occurrence of harbour accident	0	2 2.7%	31 41.3%	42 56.0%		100
5	Communication contributes to the occurrence of harbour accident.	0	0	24 32.0%	46 61.3%	5 6.7%	100
6	Stress and health of port workers contribute to the occurrence of harbour accident.	0	2 2.7%	26 34.7%	31 41.3%	16 21.3%	100
7	Human factor is a core cause of harbour accident	0	0	29 38.7%	42 56.0%	4 5.3%	100
8	Machinery/equipment failure is a major component of port/harbour accident	0	0	23 30.7%	49 65.3%	3 4.0%	100
9	Lack of periodic maintenance is a core component of port/harbour accident	0	1 1.3%	32 42.7%	42 56.0%		100
10	Over capacity usage is a major cause of port/harbour accident.	0	1 1.3%	35 46.7%	35 46.7%	4 5.3%	100
11	Fault in design/ construction of machinery/equipment has played a role in port/harbour accident.	0	1 1.3%	23 30.7%	46 61.3%	5 6.7%	100
12	Management carryout safety meetings at regular intervals	0	11 14.7%	39 52.0%	24 32.0%	1 1.3%	100
13	Accident/near accident reports are recorded by management	0	15 20.0%	39 52.0%	21 28.0%		100
14	Accident/near accident report are raised and handled in a satisfactory manner by the management	2 2%.7	13 17.3%	27 36.0%	20 26.7%	13 17.3%	100
15	Irregular storage area provided by management is a major cause of port/harbour accident	8 10.7	12 16.0%	25 33.3%	28 37.3%	2 2.7%	100
16	Failure to consider dangerous goods separation by management is a major cause of port/harbour accident	2 2.7%	11 14.7%	25 33.3%	26 34.7%	11 14.7	100
17	Coordination deficiency by management is a core cause of port/harbour accident	0	10 13.3%	41 54.7%	20 26.7%	4 5.3%	
18	Do you agree that organisational/management factor is a core cause of port/harbour accident	1 1.3%	8 10.7%	28 37.3%	28 37.3%	10 13.3%	100
19	Unfavourable weather condition played a vital role in the occurrence of port/harbour accident	2 2.7%	4 5.3%	18 24.0%	46 61.3%	5 6.7%	100
20	Do you agree that environmental factor is a core cause of port/harbour accident	4 5.3%	13 17.3%	36 48.0%	22 29.3%		100

Source: Field survey, 2024

The results obtained from table 3 shows that 6.7% of the respondents are between the ages of 17-25, 37.3% of the respondents are between ages of 26-35, while ages between 36-45 ages are 40.0% which happens to be the highest and 16.0% are between the ages of 46 - above. The results obtained from table 5 shows that 10.7% are Primary school holders, 44.0% are Secondary school which has the highest percentage, Tertiary has 30.7% and while 14.7% are none. The results obtained from table 6 shows that 45.3% are married which has the highest percentage 40.0% are single and while 14.7% are widower. The results obtained from table 7 shows that 22.7% are stevedore workers, 52.0% are terminal operators which happens

to have the highest frequency of department in the seaport in this survey, 16.0% are longshoremen, clerical are 8.0% while 1.3% are under others. Thus, clients were included in this table in other for proper accountability of results to avoid miss items in this category. The results obtained from table 8 shows that 1.3% are 0 – 12 months, 1.3% are 1 – 2yrs, 21.3% are 3 – 5yrs, 56.0% are 5 – 7yrs which happens to have the highest working experience in the seaport in this survey, 20.0% are 7yrs and above. In table 9, Major causes of harbour accident was evaluated by asking a question of does the Level of training & experience contribute to the occurrence of harbour accident Item 1 of table 9 shows that 1.3% disagree, 30.7% are neutral, 54.7% agreed, while 13.3% strongly agreed that the level of training and experience contribute to the occurrence of port/harbor accident. Item 2 of table 9. Indicates that out of 100 (100%) respondents, 4.0% disagree, 46.7% are neutral, 48.0% agreed, while 1.3% strongly agreed that fatigue has played a role in the occurrence of port/harbor accident.

Item 3 of table 9. Indicates that out of 100 (100%) respondents, 26.7% are neutral, 57.3% agreed, while 16.0% strongly agreed that unconscious behavior plays a role in the occurrence of port/harbor accident. Item 4 of table 9 Indicates that out of 100 (100%) respondents, 2.7% disagree, 41.3% are neutral, 56.0% agreed to ignorance/negligence/lack of attention plays a vital role in the occurrence of port/harbor accident. Item 5 of table 9 indicates that out of 100 (100%) respondents, 32.0% are neutral, 61.3% agreed, while strongly agreed to communication contribute to the occurrence of port/harbor accident. Item 6 of table 9 indicates that out of 100 (100%) respondents, 2.7% disagree, 34.7% are neutral, 41.3% agreed that stress and health of port workers contribute to the occurrence of port/harbor accident. Item 7 of table 9 indicates that out of 100 (100%) respondents, 38.7% are neutral, 56.0% agreed, 5.3% strongly agreed that human factor is a core cause of port/harbor accident. Item 8 of table 9 The results shows that 30.7% are neutral, 65.3% agreed, 4.0% strongly agreed that machinery/equipment failure is a major component of port/harbor accident. Item 9 of table 9. Indicates that out of 100 (100%) respondents, 1.3% disagreed, 42.7% are neutral, and 56.0% agreed that lack of periodic maintenance is a core component of port/harbor accident. Item 10 of table 9. Indicates that out of 100 (100%) respondents, 1.3% disagreed, 46.7% are neutral, and 46.7% agreed that over capacity usage is a major cause of port/harbor accident. Item 11 of table 9 indicates that out of 100 (100%) respondents, 1.3% disagreed, 30.7% are neutral, 61.3% agreed, while 6.7% strongly agreed that fault in design/construction of machinery/equipment has played a role in port/harbor accident. Item 12 of table 9 indicates that out of 100 (100%) respondents, 14.7% disagreed, 52.0% are neutral, 32.0% agreed, while 1.3% strongly agreed that management carry out safety meetings at regular intervals. Item 13 of table 9 indicates that out of 100 (100%) respondents, 20.0% disagreed, 52.0% are neutral, and 28.0% agreed accident/near accident reports are recorded by management. Item 14 of table 9 indicates that out of 100 (100%) respondents, 2.7% strongly disagreed, 17.3% disagreed, 36.0% are neutral, and 26.7% agreed that satisfactory manner by the management.

Table 10: Impact & result of harbour accident

ITEM	Options	Strongly Disagree	Disagree	Neutral	Agree	Strongly Agree	Total
1	It cost extra expenses on the management to do repairs after accidents	0	1 1.3%	18 24.0%	38 50.7%	18 24.0%	100
2	Damage of port/harbour facilities	0	0	12 16.0%	38 50.7%	25 33.3%	100
3	Loss of lives	2 2.7%	8 10.7%	26 34.7%	29 38.7%	10 13.3%	100
4	Damage of harbour facilities	0	0	28 37.3%	38 50.7%	9 12.0%	100

Source: Field survey, 2024

Item 15 of table 9 indicates that out of 100 (100%) respondents, 10.7% strongly disagreed, 16.0% disagreed, 33.3% are neutral, 37.3% agreed, while 2.7% strongly agreed that irregular storage area provided by management is a major cause of port/harbor accident. Item 16 of table 9 indicates that out of 100 (100%) respondents, 2.7% strongly disagreed, 14.7% disagreed, 33.3% are neutral, 34.7% agreed, while 14.7% strongly agreed that the failure to consider dangerous goods separation by management is a major cause of port/harbor accident. Item 17 of table 9 indicates that out of 100 (100%) respondents, 13.3% disagreed, 54.7% are neutral, 26.7%% agreed, while 5.3% strongly agreed that the

coordination deficiency by management is a core cause of port/harbor accident. Item 18 of table 9 indicates that out of 100 (100%) respondents, 1.3% strongly agreed, 10.7% disagreed, 37.3% are neutral, 37.3%% agreed, while 13.3% strongly agreed that organization/management factor is a core cause of port/harbor accident. Item 19 of table 9 indicates that out of 100 (100%) respondents, 2.7% strongly agreed, 5.3% disagreed, 24.0% are neutral, 61.3% agreed, while 6.7% strongly agreed that unfavorable weather condition played a vital role in the occurrence of port/harbor accidents. Item 20 of table 9 indicates that out of 100 (100%) respondents, 5.3 % strongly agreed, 17.3% disagreed, 48.0% are neutral, 29.3% agreed, and that environmental factor is a core cause of port/harbor accident.

In table 10, various impact of harbour accident was evaluated, Item 25 of table 10 indicates that out of 100 (100%) respondents, 1.3% disagreed, 24.0% are neutral, 50.7% agreed, 24.0% strongly agreed that it cost extra expenses on the management to do repairs after accidents. Item 26 of table 10 indicates that out of 100 (100%) respondents, 16.0% are neutral, 50.7% agreed, 33.3% strongly agreed that the damage of port/harbor facilities. Item 27 of table 10 indicates that out of 100 (100%) respondents, 2.7% strongly disagree, 10.7% disagree, 34.7% are neutral, 38.7% agreed, 13.3% strongly agreed that loss of lives. Item 27 of table 10 indicates that out of 100 (100%) respondents 37.3% are neutral, 50.7% agreed, 12.0% strongly agreed that damage of cargo handled at port/harbor.

Table 11: Indicator of performance of the port using the Ship Traffic Time and Cargo Throughput

Year	GDP	**Cargo Throughput (Tones)**	**Turnaround Time (Days)**	**Ship Traffic (No. Of Vessels)**	**Berth Occupancy Rate**
2005	23121.879	71365036	1.2	392	43.7
2006	30375.17872	70165036	1.7	402	55.4
2007	34675.94374	70265036	1.8	417	70.1
2008	39954.21189	71535636	2.8	417	33.8
2009	43461.45862	74677504	3.4	432	35.1
2010	55469.35031	70365036	2.5	619	34.8
2011	63713.35939	78281634	2.3	885	33.8
2012	72599.62997	84951927	3.4	858	35.9
2013	81009.96462	77387638	2.6	823	41.0
2014	90136.98465	70365036	2.7	865	47.2
2015	95177.73568	71535636	2.2	741	30.5
2016	102575.418	74677504	2.3	659	42.3
2017	114899.2499	81264169	2.9	671	39.1
2018	129086.9075	80826672	3.1	662	57.2
2019	145639.1394	79915877	2.8	721	59.1
2020	154252.3189	78958597	3.2	695	60.9
2021	176075.5019	80958597	3.3	765	55.9
2022	202365.0268	79958597	3.1	675	67.9

Source: NPA Statistics, 2023.

Hypothesis: There is no significant relationship between port accidents & port operational performance.

Table .12 ANOVA 1

ANOVA[a,b]

Source	Sum of Squares	df	Mean Square	F	Sig.
Regression	22835097172.190	6	3805849528.698	1.736	. <.001
Residual	32881655496.912	15	2192110366.461		
Total	55716752669.102	21			

Dependent Variable: Maritime GDP

Bayes Factor Model Summary

	Bayes Factor[c]	R	R Square	Adjusted R Square	Bayes Factor[c]
	56646331054022.266	.965	.931	.174	56646331054022.266

a. Method: JZS; b. Model: (Intercept), Slip/fall accidents occur more at port/harbor? Do you agree that port/harbor accident occur very frequently at the port/harbor?, Collision accident occur more at port/harbor? c.Bayes factor: Testing model versus full model.

The regression sum of squares (228335097172.190) is less than the residual sum of squares (32881655496.912), which indicates that more of the variation in the dependent variable is explained by the model. The significance value of the F statistic (1.736) is greater than 0.05, which means that the variation explained by the model is due to chance.

R, the correlation coefficient which has a value of 0.967, indicates that there is positive relationship between the variables. R square, the coefficient of determination, shows that 0.931% of the variation in service quality is explained by the model. Therefore, the null hypothesis should be rejected and the alternative hypothesis accordingly accepted. Thus, there is a significant relationship between port accidents & port operational performance.

The findings from the above indicated the effectiveness of safety practices and measures provided by the regulating bodies in the study area to prevent the occurrence of port/harbor accident. The study is in line with the study by Akintoye (2019) investigated the effectiveness of the Nigerian Ports Authority (NPA) in implementing safety measures in the seaport. The study found that while the NPA had put in place several safety measures, such as the use of safety signs, the provision of personal protective equipment, and regular safety inspections, there were still several areas where improvements were needed. One of the major issues identified by the study was the inadequate training of workers on safety procedures. The study found that many workers were not aware of the safety procedures and did not have the necessary skills to handle equipment safely. The study recommended that the NPA should provide regular training to workers to ensure that they are aware of the safety procedures and are equipped with the necessary skills.

On the issue of the major causes of port/harbor accidents in the study area. The study enumerated the perceived major causes by the respondents; similarly study by Manca *et al*. (2019) examined the relationship between accidents and cargo throughput in the port of Cagliari, Italy. The study found that accidents had a negative impact on cargo throughput, resulting in delays, additional costs, and reduced competitiveness. Furthermore, a study by Lee *et al.* (2020) investigated the relationship between accidents and cargo throughput in the port of Busan, South Korea. The study found that accidents had a significant negative impact on cargo throughput, resulting in delays, increased costs, and decreased efficiency. Zhang *et al.* (2017) examined the statistical relationship between port service quality and shipping traffic in global container ports. The study found that there was a significant positive correlation between port service quality and shipping traffic, indicating that ports with higher levels of service quality tend to attract more shipping traffic. Port and harbor accidents in the study area, which is the Nigerian seaport, can have significant impacts and results, both in terms of economic and environmental consequences. Some of the impacts and results of port/harbor accidents in the study area include: Economic loss: significant economic loss due to damage to infrastructure, vessels, and cargo. This can lead to delays and disruptions in port operations, which can result in financial losses for port operators and shipping companies. Also, environmental pollution which can include harm to marine life, damage to coastal ecosystems, and contamination of water sources and Safety risks: Accidents in ports can pose safety risks to workers and members of the public. This can include injuries or fatalities resulting from equipment failure or vessel collisions. The result is not in line with the study by Dutra, *et al*. (2015) which investigated the relationship between environmental factors and berth occupancy in the port of Incheon, South Korea. The study found that weather conditions, such as wind speed and precipitation, had a significant impact on berth occupancy. Specifically, the study found that high wind speeds and heavy precipitation led to lower berth occupancy rates. Similarly, a study by Liu *et al.* (2019) examined the relationship between environmental factors and berth occupancy in the port of Shanghai, China. The study found that water depth and tidal currents had a significant impact on berth occupancy. Specifically, the study found that deeper water depths and stronger tidal currents were associated with higher berth occupancy rates.

Conclusion: The Nigerian seaport of Tin Can Island experiences various types of accidents that can lead to disruptions in port operations, damage to infrastructure and cargo, and potential harm to human life and the environment. Collisions, grounding, fires and explosions, crane and equipment accidents, oil spills, and human error are among the major types of accidents that occur in the study area. The work has contributed that port accident affects the operational performance of Tin Can Island seaport.

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