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Marine Offshore Accidents in Nigeria, Causes and Necessary Preventive Measures

Oyinkepreye L. Bebeteidoh[1],Robert Poku[1] ,
[1]*Department of Marine and Mechanical Engineering, Niger Delta University, Wilberforce Island, P.M.B 071, Yenagoa, Bayelsa State, Nigeria*

ABSTRACT: *With the ground-breaking developments in the maritime industry and the implementation of safety-related regulations and the institution of International Safety Codes and Protocols, marine offshore accidents in Nigeria are still a serious concern for global maritime organizations as the rate of offshore accidents has not reduced to the expected level. Ensuring the consistency of offshore accident investigation reports is recognized as a significant goal in order to plainly ascertain the core causes of offshore accidents. This research work though limited due to poor response on the part of the respondents as regards to releasing some data that would have been helpful, the researchers were still able to investigate the core causes of marine offshore accidents in Nigeria's maritime industry. With emphasis on the scope of work essentially, data was collected through the administration of a well-structured questionnaire to selected seafarers connected with the offshore oil and gas industry in Nigeria, which included Captains, engineers, deckhands, oilers and Quartermasters. The data's collected through the administration of a self-constructed questionnaire was analyzed using the concept of the statistical tool, Chi-Square, which was considered appropriate for testing the validity and reliability of each hypothesis established in this research. The aim of this research was to determine the causes of marine offshore accidents in Nigeria, which identified that human, environmental/natural, design, and technical factors comprises the major causes of marine offshore accidents. With the findings gotten, recommendations were made which if implemented by governments and maritime organizations and adhered to by maritime operators will go a long way to reduce marine offshore accidents.*

Keywords: *Marine Offshore, Accidents,Preventive measures,and Chi-Square*

I. INRODUCTION:

Accidents are basically a shady spot in human history; they are also a source of challenge and inspiration to engineers and scientist in their drive towards crafting methods and measures in the prevention of all nature of accidents in the feature (6). Some marine accidents has had high impact on the society and has also prompted international protocols and conventions with unforeseeable consequences (14). As a result of increased oil prospecting activities in the Niger Delta region on Nigeria, there has been a tremendous increase in marine vessel accidents, leading to personal injuries, loss of lives and tremendous damage to facilities (6). According to (5) marine accidents is on the increase not minding the measures put in place to regulate such from happening.
According to (6) accidents are basically unintended happenings. While both researchers agree with this assertion, (10) opined that accidents don't just occur; they are customarily the product of several causative elements of which each one is manageable, in other words accidents are caused. Vessels sunk in waterways, shallow approaches and channels, and wrecks constitute danger to navigation and free movement of ships and crafts (5). Exploration and production of oil and gas in marine offshore environment by their nature are not fundamentally safe and are relatively multifarious and if not handled properly will lead to accident (16). (13) In his earlier research averred that there is an urgent need to set up accident and control mechanism as a result of the "epidemic" nature accidents have become.

Research has shown that key offshore accidents have ensued in several offshore platforms, ships and small craft in Nigeria's offshore region which resulted in damage to the environment, destruction of assets and loss of lives (14) (16). (5) In his earlier research noted that from 2000 through 2009, a total number of five hundred and fifty-two seafarers lost their lives due to vessel collisions and capsizing in Nigerian inland waterways. This number points to an average casualty rate of fifty-five deaths yearly excluding losses to cargos and vessels. These mishaps and accidents are attributed to factors which include environmental, technical, human factors or human

error and organizational errors (16) at sea, platforms and rigs leading to personal injuries, or death (6). (15) States that the error inducing character of the system in shipping lies in the social organization of the personnel onboard, economic pressure, the structure of the industry, and insurance and difficulties in international regulation. This research examines the present role safety plays in the maritime industry and the human factors that may contribute to the causal chain in offshore accidents. According to (12) there is a particular combination of demands characteristic of the maritime industry such as fatigue, stress, work pressure, communication, environmental factors, and long periods of time away from home, which could be potential contributors. Exemplifying that in shipping "there are a number of workplace dangers in combination, something rare in other industries" The 21st century shipping industry faces new challenges. For instance, 25 years ago the average cargo ship would have been manned with a crew of between 40 and 50 (8), but today technological advancement have contributed to a decreased manning, in some cases to just 22 seafarers on a Very Large Crude Carrier (VLCC) (9). There are two sides to the technological advances. Improvements in ship design and navigation aids have reduced the frequency and severity of shipping incidents; in turn, the reduction of failures in technology has revealed the underlying level of influence of human error in accident causation (9). The UK Marine Accident Investigation Branch (MAIB) states that "one factor still dominates the majority of maritime accidents; human error" (11).

The occurrence of a major leak event is a key cause that has the potential of resulting in a major accident (16). Also, Blow-out accidents consist of the major marine offshore accidents, like the Texaco Funiwa-5 blowout in 1980 in which, well over 400,000 barrels of crude spilled into the marine environment of Nigeria (1). A blow-out accident is a common name for uncontrolled release of hydrocarbons (gas, gas condensate and oil) from an oil and gas production well (19).

1.1 HUMAN ERROR:

(18) Defines human error as an omission or action from which liability arises, stretching from lack of training to lack of adequate experience and knowledge. (17) Defined human error as an improperly executed action or inaction or an incorrect decision. According to (9) 75-96% of offshore accidents are as a result of human error. In a recent research (7) averred that accidents that happened in lakes, crossings, seas and rivers occurred as a result of human error 65%, and only a scarce number of this is caused by natural factors as shown in figure 1. Drawing from the Costa Concordia accident research, (4) averred that the first error that led to the accident of the cruise liner was made by the Captain of the vessel, by changing the original voyage plan without coming to agreement with that local authorities and the company. This is another case of human error which did not only lead to loss of lives, but also led to permanent damage to the cruise liner and leakage of Marine Diesel Oil to the environment. In their research (3) as shown in Fig. 2 averred that human error, such as sleepiness of marine watch keepers resulting in grounding and collisions is a contributory factor of about 60% of shipping accidents, and a higher percentage for collision alone.

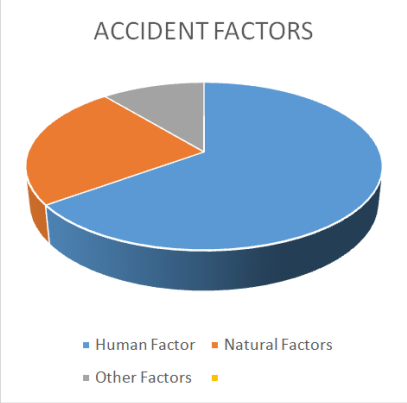

Figure1. Ship Accidents Factors (7)

1.2 TECHNICAL/ENVIRONMENTAL ERRORS:

Equipment on onboard vessels/ships are numerous. It should be of note that these equipment's are being operated by humans. According to (10) the sudden malfunction of any of these equipment ranging from propeller to rudder damage leading to accidents cannot be over looked. In their research (7) averred that just 11% of ship accidents are caused by other factor like equipment malfunction.

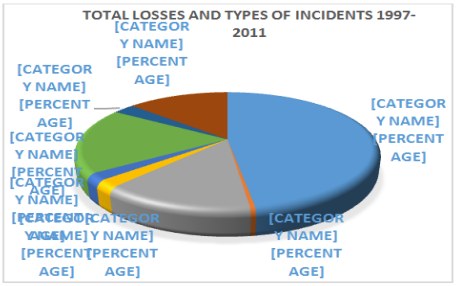

Figure 2. Ship Losses and type of incident (3)

According to (3) while foundering is a huge cause of maritime accidents, these accidents could only be associated with geographical areas, and extreme weather conditions, observed in the Black Sea and North Sea. Grounding and hitting of wrecks are other significant causes of marine offshore accidents (2).

1.3 PROBLEM STATEMENT:

The yearly increase in maritime accidents all over the world, with particular reference to Nigeria led to this study. The non-adherence to safety rules and regulations onboard vessels and platforms, the use of unregistered vessels and the non-adherence to international safety protocols at sea has led to several deaths. Year in year out the Nigerian waterways has been bedeviled with accidents leading to fatality (6). The (21) in its October 23rd, 2015 edition broke the news of the collision of "two vessels – MT Elixir and MT Tank". Both vessels collided at midstream leading to fatalities. The (20) in its February 10th, 2015 edition titled "Casualties in maritime-related accidents may rise in 2015" averred that in the year 2014 there was a ten percent increase in maritime accidents reported from 2013 . The Guardian further reported that in the year 2014 there was also a 23% year-on-year increase in vessel collision.

1.4 THE OBJECTIVE OF STUDY:

The research has shown so far that marine offshore accidents do occur year in year out, and when they do, it usually leads to loss of lives and property. Using qualitative and quantitative methods the research is aimed at fulfilling these explicit objectives.

- To determine the causes of marine offshore accidents in Nigeria
- To investigate the level of safety practices adopted onboard offshore platforms, ships and small crafts
- To evaluate the safety checks put in place by regulatory agencies in Nigeria to prevent offshore accidents
- To determine of if marine offshore accidents in Nigeria are caused by human error, environmental, management or technical errors.

1.5 RESEARCH QUESTIONS:

In achieving the above set objectives of this research, attempt will be made to answer the following research questions;

- What are the causes of marine offshore accidents in Nigeria
- What are the safety measure put in place by regulatory agencies to prevent or reduce incidences
- To what extent can marine offshore accidents be attributed to human error, technical or management
- To what extent can marine offshore accidents be attributed to environmental factors

II. METHODOLOGY AND DATA:

2.1 METHODOLOGY:

The study makes use of both primary and secondary sources of information and data to analyze the issues in contention. Data on marine accidents within the Nigerian coastal and offshore waters were obtained from questionnaires administered to marine vessel operators. The sample size chosen for this research was limited to 100 respondents consisting of rig workers, Captains and Chief mates of marine vessels that operate within Nigeria's coastal and offshore waters. The marine vessels surveyed include mainly service boats, freight barges, fishing vessels, oil tankers and tug boats. The questionnaires also provided for their responses regarding other human, environmental and vessel characteristics which they consider as related to such incidences. The researchers also used numerous electronic article databases and research articles as secondary.

2.2 ADMINISTRATION OF APPARATUS:

A total of a hundred (100) questionnaires were administered to the respondents in both public and private establishments operating within Nigeria's coastal and inland waterways stretching mainly from Lagos through

Warri to Port Harcourt Ports. These were chosen as a result of the high concentration of marine vessels, oil company activities in these areas.

2.3 HYPOTHESIS TESTED AND DISCUSSION:

To offer solutions for the research questions of this study, the following hypothesis was tested

- $H0_1$:That human factor constitute the core causes of marine offshore accidents in Nigeria
- $H0_2$: that environmental factor constitute the core causes of marine offshore accidents in Nigeria
- $H0_3$:that technical factor constitute the core causes of marine offshore accidents in Nigeria
- $H0_4$: That stricter enforcement of maritime safety rules and regulations will ameliorate the frequencies of accidents onboard offshore vessels and platforms

2.4 REPRESENTATION OF DATA:

Table 1 gives details of data collected and the nature of responses received for the 'YES' and 'NO' questions. It also shows how the questionnaires were distributed and the number of questionnaires distributed to the different groups of respondents.

The responses to the administered questionnaires as shown in table 2 (70) questionnaires were completed and returned out of the 100 questionnaires administered. Thirty (30) questionnaires or 30%, ($\frac{30}{100}$ x 100 = 30%) of the total number of respondents did not complete or return the questionnaire. These questionnaires could not be retrieved probably due to lack of willingness to complete and return them on time. The (70) completed questionnaires returned represent 70% ($\frac{70}{100}$ x 100 = 70%) as shown in table 3.

To further verify the validity of the data obtained from the field study from the table 1, 2 and 3, the use of Chi-Square analysis was then applied.
With the use of Chi-Square Analysis, the four hypotheses above were then tested;

Table 1: Sample Size Selection

RESPONDENTS	NUMBER SELECTED
CAPTAINS	10
ENGINEERS	20
DECKHANDS	20
QUARTERMASTER	20
OILERS	20
OTHERS	10
TOTAL	100

The use of the Chi-Square test was considered appropriate for testing the validity and reliability of each hypothesis. The formula used for a "Yes" or "NO" question was:

$X^2 = \sum \frac{(fo-fe)^2}{fe}$ ..... (1)

Where: fo = Observed frequency of the value;
fe = expected frequency of the value;
X^2 = calculated value;
$\sum$ = summation.
The level of confidence used was 0.05 (5%) and would be adopted for this work.
The degree of freedom was calculated as follows:
Where R = Row, C = Column total
Degree of freedom, V = (R-1) (C – 1)
R = 4, C = 2 (these values are represented in the Chi-Square distribution table, in appendix A)
= (4-1) (2-1)
= (3) (1) = 3;
$\Rightarrow$ Degree of Freedom, V = 3
The five null hypotheses were tested one after the other to ascertain their validity.

Expected value = $\frac{\text{Row Total X Column Total}}{\text{Grand Total}}$

2.5 HYPOTHESIS 1:

- $H0_1$:That human factor constitute the core causes of marine offshore accidents in Nigeria

From table 4, a total of sixty-six (66) respondents responded 'YES' while only four (4) says; 'NO' an indication that 94%, ($\frac{66}{70}$ x 100 = 94%) support the fact that human factor constitute the core causes of marine offshore accidents while only 6%, ($\frac{4}{70}$ x 100 = 6%) disagreed.

Response to this question was then analyzed in Table 4, 4a and 4b to obtain X^2.
Table 5b shows the computation for the X^2 from the different values of $fo, fe, (fo - fe)^2$, and $\frac{(fo-fe)^2}{fe}$. The theoretical value of X^2 obtained at the degree of freedom 3, and at the level of confidence of 0.05 was 7.815. Since the calculated value of X^2 = 0.241 which is less than the theoretical value, it therefore, follows that the null hypothesis as stated is valid.

2.6 HYPOTHESIS 2:

- $H0_2$: that environmental factor constitute the core causes of marine offshore accidents in Nigeria

From the field study, as shown in table 5, a total of fifty-nine (59) respondents responded 'YES' while eleven (11) says; 'NO' an indication that 84%, ($\frac{59}{70}$ X 100 = 84%) support the fact that environmental factor constitute the core causes of marine offshore accidents while only 16%, ($\frac{11}{70}$ X 100 = 16%) disagreed.

Response to this question was then analyzed in table 5a and 5b as shown to obtain X^2. The results from the computation of X^2 = 2.084. Therefore the second null hypothesis as stated is valid since the computation of X^2 is = 2.084 and is less than the theoretical value of 7.815. The null hypothesis stated earlier is valid.

2.7 HYPOTHESIS 3

- $H0_3$:that technical factor constitute the core causes of marine offshore accidents in Nigeria

From table 6, a total of fifty (50) respondents responded 'YES' while twenty (20) says; 'NO' an indication that 71%, ($\frac{50}{70}$ x 100 = 71%) support the fact that technical factor constitute the core causes of marine offshore accidents in Nigeria while 29%, ($\frac{20}{70}$ x 100 = 29%) disagreed.

Response to this question was then analyzed in table 6a and 6b to obtain X^2 ·Since the sample result fails to support the null hypothesis because the calculated value of X^2 does not fall within the acceptance region as shown in table 6b, it is subsequently concluded that something else is true, which is the alternative hypothesis H_3. This statement is specifying that the population parameter is a value other than that specified in the null hypothesis $H0_3$

2.8 HYPOTHESIS 4

- $H0_4$: That stricter enforcement of maritime safety rules and regulations will ameliorate the frequencies of accidents onboard.

From table 7, a total of sixty-seven (67) respondents responded 'YES' while only (3) says; 'NO' an indication that 96%, ($\frac{67}{70}$ X 100 = 96%) support the fact that stricter enforcement of maritime safety rules and regulations will ameliorate the frequencies of accidents onboard while 4%, ($\frac{3}{70}$ X 100 = 4%) disagreed. Response to this question was then analyzed in table 7a and 7b to obtain X^2.
The theoretical value of X^2 at the degree of freedom 3 at a level of confidence of 0.05 is 7.815. Since the calculated value of X^2 is 0.133 as shown in table 7b is below the theoretical value and within the acceptance region. It follows therefore that the null hypothesis is valid.

The validity of the four hypotheses above further confirmed the logical empirical analysis of the results obtained from the survey.

Table 2: Responses and Refusal Rate

RESPONDENTS	NUMBER	No OF RESPONSE EXPECTED	ACTUAL RESPONSE	REFUSAL RATE
CAPTAINS	10	10	10	0
ENGINEERS	20	20	17	3
DECKHANDS	20	20	10	10
QUARTERMASTERS	20	20	14	6
OILERS	20	20	13	7
OTHERS	10	10	6	4
TOTAL	100	100	70	30

Table 3: Responses to Administered Questionnaires

RESPONDENTS	No OF QUESTIONNAIRES SENT OUT"	No OF QUESTIONNAIRES RETURNDED
CAPTAINS	10	10
ENGINEERS	20	17
DECKHANDS	20	10
QUARTERMASTERS	20	14
OILERS	20	13
OTHERS	10	6

Table 4: Observed Values Compiled From the 'Yes' & 'No' Respondents

RESPONDENTS	YES	NO	TOTAL
CAPTAINS	9	1	10
ENGINEERS	15	2	17
DECKHANDS	10	0	10
QUARTERMASTERS	14	0	14
OILERS	13	0	13
OTHERS	5	1	6

Table 4a: The value of X^2 Obtained

"YES" COLUMN	"NO" COLUMN
$\frac{9\ X\ 66}{70} = 8.486$	$\frac{1\ X\ 66}{70} = 0.943$
$\frac{15\ X\ 66}{70} = 14.143$	$\frac{2\ X\ 66}{70} = 1.886$
$\frac{10\ X\ 66}{70} = 9.429$	$\frac{0\ X\ 66}{70} = 0$
$\frac{14\ X\ 66}{70} = 13.2$	$\frac{0\ X\ 66}{70} = 0$
$\frac{13\ X\ 66}{70} = 12.257$	$\frac{0\ X\ 66}{70} = 0$
$\frac{5\ X\ 66}{70} = 4.714$	$\frac{1\ X\ 66}{70} = 0.943$

Table 4b: Computation Of X^2

fo	fe	$(fo-fe)$	$(fo-fe)^2$	$\frac{(fo-fe)^2}{fe}$
9	8.486	0.514	0.264	0.031
15	14.143	0.857	0.734	0.052
10	9.429	0.571	0.326	0.035
14	13.2	0.800	0.640	0.048
13	12.257	0.743	0.552	0.045
5	4.714	0.286	0.082	0.017
1	0.943	0.057	0.003	0.003
2	1.886	0.114	0.012	0.007

0	0.0	0.000	0.000	0.000
0	0.0	0.000	0.000	0.000
0	0.0	0.000	0.000	0.000
1	0.943	0.057	0.003	0.003
				X^2 = 0.241

Table 5: Observed Values Compiled From the "Yes" & "No" Respondents

RESPONDENTS	YES	NO	TOTAL
CAPTAINS	10	0	10
ENGINEERS	13	4	17
DECKHANDS	8	2	10
QUARTERMASTERS	11	3	14
OILERS	12	1	13
OTHERS	5	1	6
TOTAL	59	11	70

Table 5a: The value of X^2 Obtained

"YES" COLUMN	"NO" COLUMN
$\frac{10\ X\ 59}{70}$ = 8.429	$\frac{0\ X\ 59}{70}$ = 0.00
$\frac{13\ X\ 59}{70}$ = 10.957	$\frac{4\ X\ 59}{70}$ = 3.371
$\frac{8\ X\ 59}{70}$ = 6.743	$\frac{2X\ 59}{70}$ = 1.686
$\frac{11\ X\ 59}{70}$ = 9.271	$\frac{3\ X\ 59}{70}$ = 2.529
$\frac{12\ X\ 59}{70}$ = 10.114	$\frac{1\ X\ 59}{70}$ = 0.843
$\frac{5\ X\ 59}{70}$ = 4.214	$\frac{1\ X\ 59}{70}$ = 0.843

Table 5b: Computation of X^2

fo	fe	$(fo-fe)$	$(fo-fe)^2$	$\frac{(fo-fe)^2}{fe}$
10	8.429	1.571	2.468	0.293
13	10.957	2.034	4.174	0.381
8	6.743	1.257	1.580	0.234
11	9.271	1.729	2.989	0.322
12	10.114	1.886	3.557	0.357
5	4.214	0.860	0.739	0.176
0	0.000	0.000	0.000	0.000
4	3.371	0.629	0.396	0.117
2	1.686	0.314	0.099	0.058
3	2.529	0.471	0.222	0.088
1	0.843	0.127	0.025	0.029
1	0.843	0.127	0.025	0.029
				X^2 = 2.084

Table 6: Observed Values Compiled From the "Yes" & "No" Respondents

RESPONDENTS	YES	NO	TOTAL
CAPTAINS	8	2	10
ENGINEERS	12	5	17
DECKHANDS	9	1	10

QUARTERMASTERS	10	4	14
OILERS	9	4	13
OTHERS	2	4	6
TOTAL	50	20	70

Table 6a: The value of X^2 Obtained

"YES" COLUMN	"NO" COLUMN
I. $\frac{8\ X\ 50}{70} = 5.714$	$\frac{2\ X\ 50}{70} = 1.429$
II. $\frac{12\ X\ 50}{70} = 8.571$	$\frac{5\ X\ 50}{70} = 3.571$
III. $\frac{9\ X\ 50}{70} = 6.429$	$\frac{1\ X\ 50}{70} = 0.714$
IV. $\frac{10\ X\ 50}{70} = 7.143$	$\frac{4\ X\ 50}{70} = 2.857$
V. $\frac{9\ X\ 50}{70} = 6.429$	$\frac{4\ X\ 50}{70} = 2.857$
VI. $\frac{2\ X\ 50}{70} = 1.429$	$\frac{4\ X\ 50}{70} = 2.857$

Table 6b: Computation Of X^2

fo	fe	$(fo-fe)$	$(fo-fe)^2$	$\frac{(fo-fe)^2}{fe}$
8	5.714	2.286	5.225	0.915
12	8.571	3.429	11.758	1.372
9	6.429	2.571	6.610	1.028
10	7.143	2.857	8.162	1.143
9	6.429	2.571	6.610	1.028
2	1.429	0.571	0.326	0.228
2	1.429	0.571	0.326	0.228
5	3.571	1.429	2.042	0.572
1	0.714	0.286	0.082	0.115
4	2.857	1.143	1.306	0.457
4	2.857	1.143	1.306	0.457
4	2.857	1.143	1.306	0.457
				$X^2 = 8.00$

Table 7: Observed Values Compiled From the "Yes" & "No" Respondents

RESPONDENTS	YES	NO	TOTAL
CAPTAINS	9	1	10
ENGINEERS	17	0	17
DECKHANDS	9	1	10
QUARTERMASTERS	14	0	14
OILERS	13	0	13
OTHERS	5	1	6
TOTAL	67	3	70

Table 7a: The value of X^2 Obtained

"YES" COLUMN	"NO"COLUMN
$\frac{9\ X\ 67}{70}$ = 8.614	$\frac{1\ X\ 67}{70}$ = 0.957
$\frac{17\ X\ 67}{70}$ = 16.271	$\frac{0\ X\ 67}{70}$ = 0.000
$\frac{9\ X\ 67}{70}$ = 8.614	$\frac{1\ X\ 67}{70}$ = 0.957
$\frac{14\ X\ 67}{70}$ = 13.40	$\frac{0\ X\ 67}{70}$ = 0.000
$\frac{13\ X\ 67}{70}$ = 12.443	$\frac{0\ X\ 67}{70}$ = 0.000
$\frac{5\ X\ 67}{70}$ = 4.786	$\frac{1\ X\ 67}{70}$ = 0.957

Table 7b: Computation Of X^2

fo	fe	$(fo-fe)$	$(fo-fe)^2$	$\frac{(fo-fe)^2}{fe}$
9	8.614	0.386	0.149	0.017
17	16.271	0.729	0.531	0.033
9	8.614	0.386	0.149	0.017
14	13.40	0.600	0.360	0.027
13	12.443	0.557	0.310	0.024
5	4.786	0.214	0.046	0.009
1	0.957	0.043	0.002	0.002
0	0.000	0.000	0.000	0.000
1	0.957	0.043	0.002	0.002
0	0.000	0.000	0.000	0.000
0	0.000	0.000	0.000	0.000
1	0.957	0.043	0.002	0.002
				X^2 = 0.133

III. RECOMMENDATION

In view of the findings and conclusions drawn from this research the following recommendations will aid in the prevention of marine offshore accidents in Nigeria and ensure sustained safety during navigation.

- Government should fully establish a body such as the Coast Guard charged with the responsibility of enforcing already existing laws and regulations that has to do with the protection of the Nigeria coastal environment. Such as criminal code of Nigeria.
- Organizations should ensure that staff onboard offshore platform, vessels and crafts adhere to companies' policies and international protocols on safety at sea.
- The Federal Ministry of Transport of Nigeria should institute a competent Port Safety Control department (PSCD) which will handle issue of safety on board ships in all ports.
- The Nigerian Maritime and Safety Agency (NIMASA) in conjunction with the Ship Owners Association of Nigeria should ensure that seafarers are trained and retrained in International best practices and safety protocols at sea.
- The Nigerian Government should remove wrecks including vessels, sunk, stranded or abandoned, jetsam, all derelicts (including logs) floating or submerged in the tidal waters constituting a great danger to navigation.
- The Nigerian Government should endeavor to dredge the estuaries to ease the smooth passage of marine vessels in order to avoid grounding.

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