The Web of Human Factors on Maritime Accidents in Nigeria: Empirical Perspective

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Abstract

The maritime industry is perhaps the most complex international industries with huge and high-risk whose incidents have high potential for the occurrences of accidents. A very large proportion of these accidents have been attributed to human factors elements. This study elucidates the dominants human factors elements that have contributed to marine accident in the Nigeria navigational waters. A descriptive survey was carried out and data collected using well-structured questionnaires distributed to 1000 respondents, out of which 821(82.1%) was retrieved. An appropriate statistical tool (SPSS Softwares-2010 Chicago version) was employed for predictors/independent variables at level of significance α =0.05. The socio-demographic results showed that majority (78.4%) of the respondents are of sound mind with over 10 years of working experience. It was found that there is a significant difference in the influences of dominant human factors elements on marine accidents in Nigeria navigational waters since $F_{computed}$ (17.345)> $F_{critical}$(1.8799).Moreso, there is a strong and positive relationship between the human factors elements and marine accidents in Nigeria, since R=0.813 and 66.1% of the variance in marine accidents can be explained by variations in the human factors elements. In addition, there is a predictable influence of the integral human factors elements on marine accident in Nigeria navigational waters. Furthermore, since, the P-value is $0.02 < 0.05$ for the multiple logistic regressions and there are differential AOR of the predictors on human factors elements marine related accidents; The generated model is efficient on human factors mitigation for marine accident reduction in Nigeria navigational waters. Six(6) out of the ten(10) identified human related factors/error namely crew fatigue, unruly behavior, unsafe vessel speed, commercial pressure from management, lack of maintenance culture, organizational structure/inadequate safety culture were frequent human causes of marine accident and are significantly related to safety performance. The highest ranking human error/factor is unsafe vessel speed of about 3.01 times higher odds of occurrence of marine accident while the least human factor is the influence of drugs and alcoholism with just 1.01 times higher odds. It is advisable for mariners to have positive and robust safety culture in place. Employers should recognize, encourage and reward Staff with impressive safety records. The Marine Safety Performance Plan of the International Safety Management (ISM) Code should be implemented in all maritime companies navigating the Nigeria waters.

Keywords: Human Factors Element , Maritime Safety, Marine Accident, Navigational

1.0 Introduction

Nigeria is the hub of West Africa's shipping activities owing to its strategic location by the coastline, vast exclusive economic zone, inland waterways, oil production and large market size. In any society where there are booming and consistent shipping activities, accident or disasters around the marine are inevitable and invariably bound to occur (Ilogu,. *et al,* 2017). From several studies, it was found that human factor/human errors elements are the main causes of marine accidents. For instance: "of a total of 880 accidents analyzed during the investigations between 2011 and 2015, Sixty –two percent (62%) were attributed to erroneous human action (EMSA2016), "Over 80% of these marine accidents were attributed to human factors elements and organizational problem (Apostol-Mates and Barbu ,2016). More so, 60% of ship accidents result from human error (Eroland, 2015). It is generally stated that 80% of all accidents at sea are as a result of human error. In fact, it is probably more correct to say that all accidents at sea were as a result of human error because, no matter how much automation is introduced into the design or operation of as hiporits systems, there is always a human input (Square et al.2015). Despite advances in technology, some 80% of all accidents in the globe were caused by human errors. Ever since, most of the published studies on maritime accidents have found that maritime accidents are caused mainly by human factors elements (Berg et al., 2013).

The maritime industry is perhaps the most complex international industries with huge and high-risk whose incidents have high potential for catastrophes. This industry constantly performs challenging operations that require a delicate interplay between human and technological factors organized in a socio-technical system to achieve complex goals such as transporting hazardous cargoes in constraint and shallow waters with much potential for human factors. Human factors happen all time and are an inevitable part of human nature. Within the maritime industry; however, human factors constitute about 90% of the marine accidents and generate critical consequences associated with costly damages to equipment, loss of lives, severe injuries or environmental pollution, so severe that they are worth spending time and resources to prevent and mitigate.

Maritime accidents affect marine environment in different ways. Not only accidents and collisions are the reasons of marine pollution, but also human errors as oil spillage, solid waste, oil transferring or bunkering accidentally may cause marine pollution. With regards to casual events and contributing factors of maritime accidents, human error is a major aspect, directly linked to more than 50% of adverse events (EMSA 2018).

The yearly increase in maritime accidents all over the world and its effects, with particular reference to Nigeria led to this study. This study focuses on the modeling of the effects of human factors on maritime accidents, categorizes and elaborate the human factors in maritime accidents, thoroughly analyzes the human factors that caused the accidents, and gives targeted measures in order to put forward certain suggestions for maritime safety management, which allows maritime accidents to be greatly reduced while minimizing damage to the environment, property and personnel.

2.0 Statement of Problem

The maritime industry that makes use of the Nigerian waters generates a substantial income into the national economy and has been a key sector of the economy. With Nigeria being an oil producing and exporting country which its economy relies densely on the revenue generated from the oil and gas sector, that contribute about 20% of the GDP, 95% of the foreign exchange

revenue and up to 65% of the revenue included in the budget, thus the marine activities has increased appreciably (Anyanwu, 2014a). At such sizeable investments have been attracted among so many other things. This has also increased the traffic and number of vessel plying the Nigerian waters which include oil tankers, container vessels, passenger vessels etc.

There is a global concern of the role of human factors in marine accidents that have caused loss of lives, damage to properties and infrastructure and the environment in the maritime industry. Maritime regulators, Maritime operators, ship owners and stakeholders in the maritime industry are all alert to the fact that Human Factors shown as the basis of marine accidents which adversely affect the effective and efficient performance of the industry. Some of the Human factor caused marine accidents can be classified into collision, contact, stranding/grounding, foundering/sinking, fire/explosion, capsized/list, machinery failure, damage to equipment, missing vessel, structural failure, heavy weather, and others. Maritime accidents adversely affect the human, environment, properties and activities aboard ships and ashore in various forms and degree of extent.

Maritime business is said to be an occupation with a high rate of fatal injuries caused by organizational accidents and maritime disasters. The shortcomings on the part of the maritime industry operators to find solutions to the myriads of marine incident in the globe might be due to lack of data and poor reporting practices related to accidents and incidents in the industry.

It can be argued that all accidents at sea are a result of human error, because invariably the human input to the design, manufacture or operation of a system is a contributory factor. Many of these human failings result from unintentional mistakes, but some are due to intentional violations of the rules and regulations put in place to prevent such risks. Others result from complacency, which leads to a lack of awareness or concern regarding real dangers or deficiencies. These violations or acts of complacency can be a result of resentment or frustration at the excessive administrative burdens that can accompany regulations, if inappropriately implemented. If adjustments are not made to account for any such increased workload, the added pressures for the master and crew might cause them to make mistakes because they are too absorbed in the 'paperwork'. Furthermore, inappropriate or overly frequent use of checklists can mean they become a substitute for thought. This can lead to a 'tick in the box' culture that, in turn, can breed complacency. Those involved in the implementation of new or existing rules and regulations do not take account of realistic human behavior, and design the associated management systems and processes to minimize any unwanted side effects.

Despite the technological advances in the maritime industry of which excessive mechanization, automation and training of staff are involved, human factors still play a vital role in the industry as most of the operations depend on its manpower to keep it running smoothly. Even in case of a natural calamity such an unexpected storm, unfavorable tides, strong winds etc. and the attacks from militants and pirates especially in the Niger Delta, there is a human hand somewhere that faltered to some extent as it comes to an interaction with human elements. Though the window for human factor is small if you consider it singly in the total operation but this single little window is where the sole of maritime operations lies. Thus, a seemingly minor error by a single person can lead to chains of errors whose consequences the industry sometimes cannot bear. It is important that the implications of such errors should be understood right up to the management level of the marine industry so that desired actions can be taken right from the top rank to the latter.

Therefore, the need for a comprehensive investigation by modelling the effects of Human Factor on maritime accidents in which this study anchored its viability cannot be over emphasized and

to proffer some solutions to reduce these problems in an attempt to bridge the gaps. Substantial gaps exist in the application of human factors to many topics, including incident investigations. The opportunity lies not only in improving the quality of insight from undesired events but shifting the energy and effort into learning about the precursors of accidents when nothing goes wrong. The challenge is therefore twofold: first, to develop a common understanding across the maritime industry to enable this change with the limited number of qualified experts, and second, to integrate human factors into core processes to reduce risk, improve efficiency, and accelerate proactive learning

This research is conducted to point out the effect of human factors on marine accidents in the Nigerian Maritime industry, so that the regulatory bodies can improve on the implementation and enforcement of safety policies. Also, so that seafarers and onshore personnel can identify and know the type, nature of the effect of human factors on marine accidents. It will enhance knowledge and assist the maritime community at large by providing vital information as related to human factors when developing new technology or rules/regulations.

3.0 Review of some cases of marine accidents in Nigeria

In June, 1997, a tanker vessel M. T. Al-Zainah exploded at Lagos, Nigeria. The last cargo of the ship was PMS (Premium Motor Spirit), later, hot work was carried out in one of the cargo tanks not properly washed and gas freed and then, an explosion occurred(Environmental safety magazine 2005). In March,1999, a tanker vessel M.T. Aribi Flooded and Sunk at Bonny Town Anchorage, Port Harcourt, Nigeria.

The tanker was fully loaded with about 2000 tons of AGO (Automotive Gas Oil) and so she had a small free board, she took in water into the engine room though the propeller shaft and later sank due to uncontrollable flooding. The entire cargo (AGO) was lost with the ship (Environmental safety magazine 2005). In April 1999, a ferry MV GEORGE sank near the city of Port Harcourt in Nigeria killing about 100 people. It was noted that it was heavily overloaded beyond its carriage capacity when it ran into a fierce storm (BBC NEWS, 1999). In October, 1999, a tanker vessel M. T. Walvi – 14 exploded in Eket offshore Nigeria. The small fresh water tanker was loading fresh water from an offshore production platform when some dangerous gases entered the cargo tank through the water hose, one of the crewmembers lit a cigarette on the main deck and there was an explosion (Environmental safety magazine 2005). In January, 2000, a tanker vessel M. T. Real Progress in Lagos Nigeria exploded. The ship was loaded with 7000 tons of PMS (Premium Motor Spirit), the PMS leaked from the pump room to the pump-motor room and the Bosun's store through the pump/pump-motor shaft hole due to malfunctioning packing. There were some chemical reactions in the pump-motor room and the Bosun's store, which generated static electricity, and then there was an explosion in the pump-motor room and the Bosun's store (Environmental safety magazine 2005). In January, 2000 a tanker vessel M. T. Crown O in Warri , Nigeria exploded. The ships compressor was bad, the chief engineer attempted to start the main engine with compressed oxygen bottle, there was an explosion and then fire. In 2009, the Nigerian Association of Master Mariners (NAMM) correlate poor pilotage services, improper lookout, inadequate lighting scheme at ports, inappropriate speed of ship, inadequate knowledge of rules of the road (ROR), and general negligence as the leading causes of marine accidents in the Nigerian coast.

In July 2000, the M.T. WALVIS 15 in Eket Nigeria, had an explosion caused by fire in the forward store. It was found that the cause of the explosion was a static electricity that arose after two operational deep freezers, an oxygen bottle and full acetylene bottle locked in the forward

store developed leakages from their compressors thus starting the fire. The incident was attributed to the absence of a firm technical safety culture (Onyemechi, et al., 2016). On the 16th of January 2012, an offshore rig owned by Chevron caught fire and eventually collapsed into the ocean near North Apoi oil platform off Nigeria's coast. Two personnel were reported dead. The cause of the accident was said to be human error as the workers could not contain the gas pressure build up which eventually led to the fire (The Guardian, 2012).

On the 19th of October 2015, a Marshal Island flagged oil products tanker collided with a Nigerian self-propelled barge MT Tank at 65 miles off the Nigerian coast, which is 10 nautical miles southwest of the Bonga floating Production Storage and Offloading (FPSO) Unit located near Warri in Delta State, Nigeria. The collision broke the MT Tank causing it to take in water. According to reports from the search and rescue personnel of the Nigerian Maritime Administration and Safety Agency (NIMASA), eight crew members of the MT Tank were trapped inside the vessel which led to the death of a crew member. The cause of the collision was attributed to negligence and bad seamanship (World Maritime News, 2015). On 15th August, 2019 a Product tanker Sea Voyager caught fire while being anchored at Lagos Anchorage, Nigeria.

The Guardian 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 Guardian 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. The Daily post in its November 11, 2016 edition broke the news of a National Youth Service Corps (NYSC) member is feared drowned in a boat accident on Thursday in Okpotuwari Community in Southern Ijaw Local Government Area of Bayelsa. Sources in the community told the News Agency of Nigeria (NAN) on Friday that the corps member, who hailed from Anambra drowned when the canoe he boarded capsized.

The Sun in its July 30, 2018 edition broke the news of six persons reportedly drowned when a passenger boat from Abonnema Wharf to Bakana in Degema L.G.A of Rivers State capsized. It gathered that 25 persons were onboard the boat. The BBC Pidgin in its August 9, 2018 edition broke the news of Okrika boat accident: police don see dead bodi of two pikin wey miss wey happen last Sunday when the speed boat capsized. The Vanguard in its November 20, 2018 edition broke the news of Anger as 3 die in Bonny River Boat mishap. Also, the Punch in its March 11, 2019 edition broke the news of four persons have been confirmed to be missing following a boat accident that occurred on the waterways of the Benin River in the Warri North Local Government Area of Delta State.

It is obvious that the rate of death due to marine accidents has not reduced as the most recent boat incident occurred on the 14th of September, 2017 in kebbi state, Nigeria claiming over 50 lives (Vanguard, 2017). Sahara Reporters had reported that the Chief Executive Officer, LASEMA, Dr. Olufemi Oke-Osanyintolu, said the boat capsized due to overloading, adding that three persons were rescued and taken to hospital. An on-the-spot investigation carried out by LASWA revealed that the incident was caused by poor visibility on the part of the captain.

According to Dr. Olufemi Oke-Osanyintolu the Chief Executive Officer of LASEMA: "A boat accident occurred at the Ipakan Boat Jetty, Egbin, Ikorodu, on Saturday, June 29, 2019. Investigations revealed that the boat was travelling from Badore, Ajah to Egbin in Ikorodu with between 17 and 21 passengers on board. (Sahara Reporters, 2019)

On July 11, 2019 12 dead bodies were recovered while others were still missing, according to the

Lagos State Waterways Authority. On its part, the National Inland Waterways Authority put the death toll at 10, eight missing passengers and three survivors. (Punch, 2019)

On the 5th March 2021, Barge Crystal 21 left **Port and Cargo Jetty** at Tincan Island Port headed from **Brawal Jetty to off load**. The Barge was pushed by a Tug Boat MV MARCY II to Brawal Jetty. But at about 0200HRS on the 6thMarch, 2021, according to the General Manager of **Equal Logistic** the Charterers of the Barge said that the Barge started listing as a result of ingress of water into the Barge and finally dropped part of the container into the water. The Barge was loaded with 21 containers and was secured abreast **SB2 Barge** which was double banked with another **Barge ETSL 02** tied to the Jetty. All efforts to salvage the Barge at that time of the day yielded no positive efforts. Consequently, the Barge continued to list further, and the containers began to fall overboard early hours of Saturday 6thMarch, 2021. (NIMASA REPORT 2021). On Monday 15thMarch, 2021 at about 0500hrs, a Tugboat (DAN LICIA 2) pushing a barge (TOMAHAWK) sank along the channel between Kirikiri and Tincan, (NIMASA REPORT 2021)

On September 23, 2016 a fatal mooring accident occurred to the Bosun of the Cyprus registered Bulk Carrier "Carme", at Lagos/Apapa Nigeria. M/V "CARME" berthed at ENL Terminal, Berth No 9, Apapa/Lagos/Nigeria. On September 1, 2016 the Bulk Carrier "Carme" departed from Houston (TX)-USA, loaded with cargo of corn, bound for Lagos-Nigeria. On September 22, arrived at the port of Lagos. On September 23, the Bosun was fatally injured during emergency unmooring operation. The Bosun was struck by a mooring line, which he was handling, while he was standing at the forecastle deck starboard side in front of a winch drum. The area where the Bosun was standing was within the snap-back zone of the parted mooring line (Snap-back zones are typically spaces where it is anticipated a failed mooring line could recoil).

The Bosun died as a result of (a) Multiple injuries (b) Blunt force trauma. With respect to the manner of death, it was caused by struck by mooring rope.

The other Contributing Causes were:

1. The environmental conditions were a factor in the accident (Strong ebb current in conjunction with inadequate under-keel clearance-Vessel was neither safely afloat nor safely aground).
2. No Specific Risk Assessment and no Tool-Box-Talk for emergency unmooring.
3. The strong ebbing current under the vessel's flat bottom in conjunction with the vessel's grounding, its listing to stbd and trim by the stern, was pushing up the stem causing extreme tension of the forward mooring lines, resulting in their breaking.
4. Insufficient information given to the Master regarding drafts alongside berth and tidal ebbing effect.
5. Failure on the part of the Bosun to recognize the danger of coming within snap-back zones of taut mooring lines.

According to Capt Tobi, as a result of the accident part of the breakwater has submerged, even as he called on the authorities to quickly rehabilitate the facility before more accidents occur on that axis of the port. He explained that because the mole was submerged, the vessel did not know it was close to it and ran into the mole and got its bottom hull damaged. The vessel, according to Captain Tobi, is currently sitting on the rocks of the mole (Vanguard, 2020).

This is one of the detriments of marine accidents in Nigeria. The death toll as related to marine accidents keep on increasing in the Nigerian waters. It is found that the predominant type of accident that causes the most loss of lives in the Nigerian waters is the boat and ferry accidents (Ukoji & Ukoji, 2015). This is because water-borne transportation has emerged as an alternative

means of transport in Nigeria. Amidst the great usage of water as a means of transportation in Nigeria, very little attention is being given to itin terms of safety. At such boat and ferry mishap is frequent and fatality rate increased. The common causes of the mishaps include collision and capsizing.

According to The Guardian Newspaper of 2nd June, 2021, The Guardian estimates that about 347 people have lost their lives to avoidable accidents on the waterways, while the National Inland Waterways Authority (NIWA) gave 168 persons as the estimated figure of casualties in the last one year. This is even as many have called on the country to fully explore its water resources for transportation. The latest was the Kebbi State incident where over 160 people drowned after an overloaded boat ferrying passengers to the market sank in Niger River.

Chairman, Kebbi State Emergency Management Agency, Sani Dododo, said 60 bodies have been recovered so far while 83 missing passengers might not be found alive. Sanni said 22 passengers were rescued shortly after the accident. "Not a single person has been rescued alive since then. Among the dead was a baby of less than a year," he said.

Boat accidents are common in Nigeria, especially on the Niger River and Lagos with causes including overloading, poor condition of boats and underwater debris. Early last month, 30 people drowned when an overloaded boat capsized in Niger State. This was just as the nation was getting relief from the July 2020 incident, when a boat ferrying 100 local traders split into two after hitting a stump during a storm as they were returning from a local market. In the same month, about 28 passengers were feared dead when their overcrowded boat capsized in Benue state, while another seven people were confirmed dead in Ikorodu outside the economic hub of Lagos when their boat sank following heavy rain.

Besides, no fewer than 13 persons were confirmed dead in August 2020, after a boat capsized in Lagos. The Lagos boat accident occurred around 5:45 pm at Kirikiri, Apapa, less than 24 hours after 18 people cheated death in two boat accidents on Victoria Island. Earlier in July 2020, eight passengers died in a boat mishap in Ikorodu Lagos. An industry expert, Joseph Igbokwe said: "It is very absurd to read regularly, reports about boat mishaps resulting in loss of lives and properties instead of breakthroughs made by marine engineers and naval architects on shipbuilding, efficient wreck removal and ship recycling. "It is equally disturbing when the causes of a ship capsizing in the country are repeatedly, common requiring little government intervention to avert them but without necessary official concerted efforts to reverse the ugly trend of loss of enormous resources."A student of the Nigeria Maritime University, Okerenkoko, in the Warri South-West Local Government Area of Delta State, has drowned in a boat accident along the Warri River. A caterer attached to the varsity was also reported dead in the private boat accident. Sources said the ill-fated boat capsized on Friday when the deceased and other passengers were travelling from the university community to Warri.

PUNCH Metro gathered that aside from the two victims, other students who boarded the boat survived. A student, who survived the accident, said some of the passengers, including locals, did not wear life jackets and did not know how to swim. The student, who did not want his name in print, noted that the lifeless bodies of the deceased were later recovered by local divers. Our correspondent gathered that the deceased student, an Ijaw, was buried by

his family on Friday, while the corpse of the caterer was deposited in the Warri Central Hospital morgue (Punch metro 4th October, 2021).

A Floating Production, Storage and Offloading (FPSO) vessel TRINITY SPIRIT with a capacity to process up to 22,000 barrels of oil per day, inject up to 40,000 barrels of water per day and store 2 million barrels of oil, exploded and sunk at the Ukpokiti Terminal, around Excravos, Warri South-west, Delta State, Nigeria.The Floating Production, Storage and Offloading FPSO TRINITY SPIRIT, IMO 7370325, dwt 274774, built 1976, off AIS for a long time, years probably. Owner Shebah Exploration and Production Company Limited (SEPCOL)

According to the first information, ten workers were onboard the facilities, of which seven are missing, and three casualties feared. The incident is confirmed by owner SEPCOL: "The management of Shebah Exploration & Production Company Ltd (SEPCOL) in receivership, hereby announces the unfortunate incident of a fire that engulfed our offshore facility, the FPSO Trinity Spirit located at the Ukpokiti Teminal, following an explosion during the early hours of Wednesday, 2nd of February 2022. Three crew members on board an oil vessel that exploded last week off the coast of Nigeria have been found alive, while seven were still missing, according to the ship's operator.According to Africa HSE Group (2017) findings, it indicated that most of the boats and Ferries are overloaded with passengers thereby making capsizing imminent. This is because there are no safety regulations put in place to check overloaded vessels. The National inland Waterways Authority (NIWA) statistics in 2013 depicts that out of the 36 states in Nigeria, 28 states make use of water as a means of transportation. Their statistics recorded that over 350 lives were lost to boat marine accidents just in 2013.

A typical case with serious fatality in Nigeria in recent time is the case of the 'JASON 4' where the oil service tugboat drowned off the coast of Nigeria killing 10 of the 11 crew members onboard in 12/05/2013 11:43 am ET **Updated** Jan 23, 2014. The cook Harrison Odjegba Okene survived in an air bubble in the wreckage and was rescued, possibly the only case someone survived in a sunken ship (Live Science 2014).In other parts of the world, when such accidents happen, those responsible are never allowed to go unpunished. For instance, in Hungary, a 54-year-old captain of the vessel that collided with a small tour boat in River Danube last month, resulting in at least seven deaths, was arrested. The Ukrainian national was held for "reckless misconduct in waterborne traffic, leading to mass casualties," a BBC report said.A similar action was taken when a Korean ship, Sewol, sank near Jindo Island in 2014, resulting in 304 deaths, mostly schoolchildren. Apart from arresting the captain, the teacher who took them on the tour, facing the prospect of prosecution, also committed suicide. In Nigeria, people should also be made to take responsibility for their actions.

4.0 Research Methodology

The study employed a survey design in which primary data used for the study was obtained by the use of questionnaire as survey instrument. The questionnaire was administered to shipping crew members, master mariners, marine engineers, sailors, deck crew, cargo surveyors, safety coordinators and other on-board technicians at Onne Port Complex, Port Harcourt Port Complex, Warri Port Complex, Calabar Port Complex, Tin-CanIsland Port Complex, Lagos Port Complex and jetties within the Nigerian navigational waters. The target population of (1000) constitutes the maritime operators at the Ports and jetties. Out of which, 821 (82.1%) was retrieved. This study employed descriptive and quantitative approach. This could include personal observation

of watch keepers, post-accident analysis/statistical analysis of computerised accident records, analysis of voluntary incident reports, carrying out a survey/interview, designing and carrying out simulator experiments, personal logs, and observations using remote radar are possible research methods. Out of which, carrying out a survey/interview was employed as the research method for the purpose of achieving the aim of this study.

This study was designed to determine influences on Human factors contributing to marine accidents. The independent variables of the study in terms of the quantitative approach was the Human factors contributing to the occurrences of marine accidents and the dependent variable was the marine accident graded with respect to its severity.

Descriptive statistics were used to summarize the marine accidents report data, and inferential statistics were used to generalize the findings of the study to the entire population using the Statistical Package for Social Sciences (SPSS) Version 16.0 software computer program with the assistance of a statistician. Two sets of data were used in the analysis. The first set consists of marine accident reports from the six major seaports and an attachment to Navigational waters. Grades were assigned based on the level of severity of the accidents as follows: Negligible =1 Slight =2   Moderate =3   Serious =4   Very Serious =5. The second set consists of responses from respondents obtained with a structured questionnaire coined as Qualitative data. The response options in the instruments (Questionnaires) are weighted as shown below: Strongly Agree (SA) = 4 points, Agree (A) = 3 points, Disagree (D) = 2 points, Strongly Disagree (SD) = 1 point. Analysis of the respondents' responses from the items involved the researcher breaking down the data into segments of information and then assigning the segments identifying labels to develop categories. The frequency distribution of the primary data will be presented principally to give one an idea of the distribution of respondents' demographic characteristics in Section A of the questionnaire. Analysis of the data is discussed in line with the research objectives and questions. Once the responses had been analyzed and labeled based on the researchers' categories, the researcher reported the findings in summarized statements and the null hypotheses tested at 0.05 level of significance using the following inferential statistics :

    i.   Frequency Distribution
    ii.   ANOVA Analysis
    iii.   Multiple linear regressions model
    iv.   Multinomial logistic regression

5.0 Results and Discussions

It is necessary to unravel the status of the respondents in such a sensitive study as this research and Table 5.1 shows the socio-demographic distribution of the respondents. From Table 5.1, reveals that majority of the respondents (45.3%) were between the ages 31-41 years. Similarly, 30.3% of respondents were aged 18-30 years and 24.4% were above 41 years of age. This means that 75.6% of the respondents were considered young, energetic, and still in their productive working age. Majority of the respondents were on-board officers (39.1%) holding HND/BSc degree, (32.4%) with NCE/OND, and 78.4% of them having more than 10 years maritime experience, out of which 45.6% have maritime experience of16 years and above and 16.4% respondent at management cadre. Given these characteristics, they were expected to be of sound mind and body to understand the main theme of this investigation and to make meaningful contributions.

Several factors are related to marine accidents in Nigeria navigational waters. Human factors

are contributory factors to marine accidents and relationships exist between them and safety culture, hence, human factors can predict safety performance in maritime organizations in Nigeria. The study showed that ten (10) human related factors are major causes of marine accidents; in Nigeria namely: communication problem, crew fatigue, unruly behaviour, safe vessel speed, and commercial pressure from management, improper hazard management, lack of maintenance standard, organizational structure/inadequate safety culture, inexperience/lack of adequate knowledge.

The constituents of Human factors do not contribute equally towards marine accident incidence in the Nigeria. The result also showed that six (6) out of the ten human related factors/error namely crew fatigue, unruly behavior, unsafe vessel speed, commercial pressure from management, lack of maintenance culture, organizational structure/inadequate safety culture were frequent human causes of accident and significantly related to safety performance while four (4) were not regarded as serious human errors that result in accident. These results are in agreement with previous studies carried out by Dogarawa (2012) and Onwuegbuchunam (2013) that argued that "poor communication between crewmembers who are not speaking the same language can, through misunderstandings and mistakes, be a threat to the overall safety of a vessel." Furthermore, the more conscious individuals are about these factors and their readiness to address them in daily work, the more improved the safety culture in their day to day operations.

The P-value is 0.02 < 0.05 for the multiple logistic regressions; there exist a statistically significant relationship within the predictors (independent variables) and incidence of marine accident in the Niger Delta. Therefore Research Hypothesis 1 is accepted. From Table 4.2, more specifically inadequate communication within the crew members as a problem or human error had 1.94 times higher odds of causing marine accident compared to the chances of such inadequacies of not causing marine accident.

The variability of the AOR for the predictors unraveled that their odd contributions to marine accidents differs, therefore, Research Hypothesis 2 is rejected and the Null Hypothesis accepted. Crew fatigue had 2.13 times higher odds; unruly behavior had 2.02 times higher odds, while the highest ranking human error/factor is unsafe vessel speed of 3.01 times higher odds, followed by lack of maintenance culture with 2.98 times higher odds, then commercial pressure from management having 2.86 times higher odds. The least human factor from the study is influence of drugs and alcoholism with just 1.01 times higher odds. The reduced value of influence of drugs and alcoholism might have been the strict compliances of mariners to safety rules and regulations as regards to hard drugs and alcohols. In addition, the disciplinary actions taken by the management of the marine companies where employees lost their jobs is another factor that has drastically reduced marine accidents due to the influence of drugs and alcoholism.

In order to prevent the occurrence of marine accident, it is advisable for mariners to having positive and robust safety culture in place and specifically by avoiding unsafe vessel speed, improving communication within the crew on board ,ensuring proper feedback mechanism, training and retraining staff, ensuring accurate safety/hazard analysis, holding daily safety meeting, prompt incidence reporting, stiff punishment to defaulters, avoiding wrong use or non-usage of sound signals in restricted visibility areas, proper look out and observing collision regulations etc. It is also advisable implement stress management policy to the latter to address issues of crew fatigue. It is also recommendable to recognize and reward staff with impressive records of safety which is a sure way to improving safety performance and reducing accidents in Nigeria maritime industry.

Table 5.1: Socio-demographic characteristics of the respondents

Variables	Frequency	Percents (%)
Age		
18-30	248	30.3
31-40	372	45.3
> 40	201	24.4
Educational status		
FSLC	19	2.4
SSCE	118	14.3
NCE/OND	266	32.4
HND/B.Sc/B.Tech/B.Eng	321	39.1
Master's Degree	37	4.5
Certificate of Competency	60	7.3
Years of Experience		
0-5	40	4.9
6-10	137	16.7
11-15	270	32.8
≥16	374	45.6
Official Ranks		
Directors	22	2.8
Manager	63	7.7
Supervisor	48	5.9
Engineer	191	23.3
Mechanic	65	8.0
Specialist/ Advisor	34	4.2
Operator/Technician	52	6.3
Shore-Based Personnel	89	10.8
On Board Officers	153	18.7
Safety Officers	74	9.01
Crane Operators/Others	30	3.65

FSLC:FirstSchoolLeavingCertificate;SSC:Senior SecondaryCertificate;NCE/ND:NationalCertificate/ NationalDiploma;HND/BSc/Bng:HigherNational Diploma/Bachelor'sdegree ■

5.2: Results from Analysis of Human Factors influences on marine accidents
5.2.1:Test of Hypothesis 1
Null Hypothesis H_1: There is no significant difference in the influences of each of the human factors constituents on marine accidents in Nigeria navigational waters at $\alpha = 0.05$: .i.e. $\mu_1 = \mu_2 = \mu_3 = \mu_4 = \mu_5 = \mu_6 = \mu_7 = \mu_8 = \mu_9 = \mu_{10}$

Research Hypothesis H_1: There is a significant difference in the influences of each of the human factors constituents on marine accidents in Nigeria navigational waters at $\alpha = 0.05$

d.f.N = degree of freedom number of groups = k – 1=10 – 1 = 9
d.f.D. = degree of freedom sample sum = N – k = 241-10 = 231
Where: k is number of groups = 10 and N is sum of all samples = 241
From the F-distribution table, the critical value obtained at $\alpha = 0.05$ is 1.8799.

Table 5.2 : Summary of Computed F- Distribution

Groups	Count	Sum	Average	Variance
X_1	4	1.100	0.220	0.000
X_2	4	1.600	0.220	0.000
X_3	4	1.946	0.269	0.014
X_4	4	2.907	0.392	0.042
X_5	4	2.673	0.373	0.032
X_6	4	2.241	0.302	0.019
X_7	4	1.623	0.233	0.000
X_8	4	1.319	0.190	0.015
X_9	4	1.643	0.212	0.001
X_{10}	4	0.293	0.061	0.006

ANOVA

Source of Variation	SS	Df	MS	F	P-value	F crit
Between Groups	1.546	9	0.098	17.345	0.000	1.8799
Within Groups	1.024	231	0.012			
Total	**2.570**	**240**				

Since $F_{computed}(17.345) > F_{critical}(1.8799) \rightarrow$ **Reject Null Hypothesis and Accept Research Hypothesis**

5.2.2: Test of Research Hypothesis 2 :(Using the Multiple Regression)
Null HypothesisH_2:.There is no significant relationship between human factors elements and marine accidents in the Nigeria navigational watersat $\alpha = 0.05$.
Research HypothesisH_2:.There is a significant relationship between human factors elements and marine accidents in the Nigeria navigational watersat $\alpha = 0.05$.

The equation for the regression model is given as (since there are ten independent variables)

$$Y = a + b_1(X_1) + b_2(X_2) + b_3(X_3) + b_4(X_4) + b_5(X_5) + b_6(X_6) + b_7(X_7) + b_8(X_8) + b_9(X_9) + b_{10}(X_{10}) + \mu \ldots \ldots \ldots (1)$$

Where $X_1, X_2, X_3, X_4, X_5, X_6, X_7, X_8, X_9$ and X_{10} are the independent variables

X_1 = communication problem

X_2= crew fatigue

X_3 = unruly behaviour

X_4 = unsafe vessel speed

X_5 = commercial pressure from management

X_6= improper hazard management

$X_{7=}$lack of maintenance standard

X_8 = organizational structure /inadequate safety culture

X_9 = inexperience/lack of adequate knowledge

X_{10}= Influence of drugs and alcoholism

Y = Human Error Associated Marine accidents

a = is the intercept

$b_1, b_2, b_3, b_4, b_5, b_6, b_7, b_8, b_9$ and b_9= partial regression coefficients

μ is the error term and N = total number of observations = 241

Table 5.3: Regression Model Summary

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate
1	.813[a]	.661	.614	16.35712

Coefficient of multiple correlation R = 0.813→ Strong and positive relationship

Coefficient of determination (R^2) = 0.661→about 66.10% of the variance in the marine accidents can be explained by variation in human factors variation

5.2.3: Test of Research Hypothesis 3(Generating Multiple Regression Model)

Null Hypothesis H$_3$: There is no predictable influence of the integral human errors elements on marine accident in the Nigeria navigational waters.

Research Hypothesis H$_3$: There is a predictable influence of the integral human errors constituents on marine accident in the Nigeria navigational waters.

d.f.N = degree of freedom number of groups = k – 1=10 – 1 = 9

d.f.D. = degree of freedom sample sum = N – k = 241-10 = 231

Where: k is number of groups = 10 and N is sum of all samples = 241

Level of significance α: 0.05

The critical value obtained at α = 0.05 is 2.320

Table 5.4:ANOVA[a] Analysis of Multiple Regression

Model		Sum of Squares	Df	Mean Square	F	Sig.
1	Regression	39195.687	9	7413.217	18.241	.000[b]
	Residual	32411.664	231	292.426		

Total	71607.350	240			

a. Dependent variable: *Human Factors Associated Marine accidents*

b. Predictors: *communication problem, crew fatigue, unruly behaviour, unsafe vessel speed, and commercial pressure from management, improper hazard management, lack of maintenance standard, organizational structure /inadequate safety culture, inexperience/lack of adequate knowledge and influence of drugs and alcoholism.*

Table 5.5: The Multiple Regression Coefficients

Model	Unstandardized Coefficients		Standardized Coefficients	T	Sig.
	B	Std. Error	Beta		
(Constant)	588.868	1123.404		.524	.602
X_1	11.049	2.799	.323	3.948	.000
X_2	8.798	1.242	-.613	-7.434	.000
X_3	3.228	.737	.053	.678	.500
X_4	51.324	14.540	.303	3.530	.001
X_5	24.869	4.382	.247	2.629	.531
X_6	4.488	28.543	.012	.157	.875
X_7	32.450	9.456	.231	1.936.	.500
X_8	4.583	0.818	.062	.401	.001
X_9	5.219	1.002	.088	.316	.000
X_{10}	1.065	0.043	.0324	.111	.000

a. Dependent Variable: Human factors Associated Marine Accidents

$$Y = 588.868 + 11.049 * X_1 + 8.798 * X_2 + 3.228* X_3 + 51.324 * X_4 + 24.869 * X_5 + 4.488 * X_6 + 32.450 * X_7 + 4.583 * X_8 + 5.219* X_9 + 1.065 * X_{10}$$

Therefore, we reject the Null Hypothesis and accept the research Hypothesis. This implies that the integral influences of human factors on marine accidents are predictable.

5.2.4 Test of Research Hypothesis 4

Null Hypothesis H$_4$:The generated model is not efficient on human factors mitigation for marine accident reduction in Nigeria navigational waters (at $\alpha = 0.05$).

Research Hypothesis H$_4$:The generated model is efficient on human factors mitigation for marine accident reduction in Nigeria navigational (at $\alpha = 0.05$).

By employing the Multinomial Logistic regression analysis of Human factors elements on Marine Accidents Predictors or independent variables in Nigeria navigational waters as shown in Table 4.6, the results are as follows:

Table 5.6: Multinomial Logistic regression analysis of Human factor's on Marine Accidents Predictors in Nigeria

Predictors	Frequency	Percents (%)	AOR(95% CI)
Communication problems			
Yes(1)	509	62.5	1.94(1.03-2.41)
No(0)	311	37.5	1
Crew Fatigue			
Yes(1)	690	84	2.13(1.60-3.01)
No(0)	131	16	1
Unruly Behaviour			
Yes(1)	541	66	2.02(1.40-2.72)
No(0)	279	34	1
Unsafe Vessel Speed			
Yes(1)	743	90.6	3.01(1.90-3.23)
No(0)	77	9.4	1
Commercial Pressure from Management			
Yes(1)	796	97	2.86(1.52-2.94)
No(0)	24	3	1
Improper Hazards management			
Yes(1)	495	60.3	1.99(1.12-2.56)
No(0)	326	39.3	1
Drugs and Alcoholism			
Yes(1)	57	7	1.01(1.00-1.01)
No(0)	764	93	1
Lack of Maintenance Standard			
Yes(1)	722	88	2.98(2.02-3.07)
No(0)	99	22	1
Organisational structure/Inadequate Safety Culture			
Yes(1)	640	78	2.02(1.51-2.86)
No(0)	181	22	1
Inexperience/Lack of adequate Knowledge			
Yes(1)	246	30	1.07(1.01-1.21)
No(0)	575	70	1

Since there are differential AOR of the predictors on the Human factors elements marine related accidents, therefore, we reject the Null Hypothesis and accept the research Hypothesis. This implies that the generated model is efficient on human factors mitigation for marine accident reduction in Nigeria navigational waters (at $\alpha = 0.05$ or CI =95%).

5.0 Conclusions and Recommendations
6.0
6.1 Conclusions
Based on the finding from this study, it can be concluded that: Human factors are major contributory factors to marine accidents in the Nigeria navigational waters. Communication problem, crew fatigue, unruly behaviour, safe vessel speed, commercial pressure from management, improper hazard management, lack of maintenance standard, organizational structure/ inadequate safety culture, inexperience/lack of adequate knowledge, maritime education are major causes of marine accident in the Nigeria.

The constituents of Human factors do not contribute equally towards marine accident in the Nigeria

Crew fatigue, unruly behaviour, unsafe vessel speed, commercial pressure from management, lack of maintenance culture, organizational structure/inadequate safety culture were significantly related to safety performance

There is lack of transparency in maritime authorizes in revealing the causes of marine accidents, so that stakeholders cannot determine the appropriate measures to prevent marine accidents due to the same cause.

6.2: Recommendations
To reduce the accidents, there should be more attention to the factors such as crew fatigue, unruly behaviour, unsafe vessel speed, commercial pressure from management, lack of maintenance culture, organizational structure/inadequate safety culture, non-implementation of national and international laws and regulations.

Marine Safety Performance Plan, which is part of the International Safety Management (ISM)Code, should be implemented in all maritime companies in Nigeria.

The systems and operation control need to be reviewed and evaluated regularly and the content should cover management system, procedure, human factor engineering, exercise, immediate supervision, communication, maritime education and individual performance.

Establishment of a basis for all operations in the management system which refers to the documentation control, investigation management and risk management.

Recognize and reward staff with impressive records

Expertise, competency and skill should key to the optimal performance and quality delivery in the Nigerian Maritime industry. Maritime education should be encouraged by all stakeholders in the industry.

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