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The Causes and Minimization of Maritime Disasters on Passenger Vessels

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Abstract- The issue of maritime disaster has become very worrisome to all stakeholders of the maritime industry, particularly the main actors in the industry. The causes and the consequent effects of maritime disasters are so numerous hence justifies this research work. Research and statistics show that human error is to blame in over 70% of marine accidents. As a matter of need and concern to the researcher and the maritime industry, the researcher was angered to carry out this work on minimization of maritime disasters with the view of contributing to the way of minimizing this menace. Research problems were stated while research questions were also formulated in order to help address the problem statements of this subject. Statistical data were extracted from Mikael E and Oscar E. on Maritime disasters from 1852 to 2011. The data collected were analysed and findings were also made. The finding shows the causes and the effect of maritime disasters such as poor education and training, inadequate policies and procedures, external factors like bad weather, Technical factors like unavailability of advanced equipments like GMDSS, human factor and its effects such as financial loss to both, the ship owner and the nearby local communities is huge, loss of job, collision with an offshore structure or a port leads to infrastructure damage and thus cause a heavy blow to human efforts among others. Recommendations such as proper implementation of the latest STCW requirements, master took the proper measures (such as reduce speed, change course, go to a safe place, send distress signal, putting in place advanced technology systems that would reduce the risk of accidents were made at the end of the research to help curb this ugly menace.

Keywords: disaster, maritime, minimization.

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THECAUSESANDMINIMIZATIONOFMARITIMEDISASTERSONPASSENGERVESSELS

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Abstract- The issue of maritime disaster has become very worrisome to all stakeholders of the maritime industry, particularly the main actors in the industry. The causes and the consequent effects of maritime disasters are so numerous hence justifies this research work. Research and statistics show that human error is to blame in over 70% of marine accidents. As a matter of need and concern to the researcher and the maritime industry, the researcher was angered to carry out this work on minimization of maritime disasters with the view of contributing to the way of minimizing this menace. Research problems were stated while research questions were also formulated in order to help address the problem statements of this subject. Statistical data were extracted from Mikael E and Oscar E. on Maritime disasters from 1852 to 2011. The data collected were analysed and findings were also made. The finding shows the causes and the effect of maritime disasters such as poor education and training, inadequate policies and procedures, external factors like bad weather, Technical factors like unavailability of advanced equipments like GMDSS, human factor and its effects such as financial loss to both, the ship owner and the nearby local communities is huge, loss of job, collision with an offshore structure or a port leads to infrastructure damage and thus cause a heavy blow to human efforts among others. Recommendations such as proper implementation of the latest STCW requirements, master took the proper measures (such as reduce speed, change course, go to a safe place, send distress signal, putting in place advanced technology systems that would reduce the risk of accidents were made at the end of the research to help curb this ugly menace.

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I. Introduction

According to Faulks (1990), the essence of maritime transport is to facilitate shipping activities by providing avenues through which large quantities of goods or freight can be transferred from one geographic space to another through water. In order to realize the principles objective of maritime transport, four important elements are necessary and these elements constitute maritime transport systems. These four elements are the vessel or vehicle, the way, the motive power and the terminal.

Following Garrick B. J (1999) there are several basic aspects of maritime activity that make it unique: ships are confined and isolated systems, self-sufficient on energy supply, they have a limited manpower and resources, and they have a limited response capacity to face emergencies. These particular characteristics made maritime trade a risky activity, where a fault in navigation or in usual port operations can give rise to injuries or lost of life, to damage of property and sometimes irreparable damage to maritime environment. Environmental and operational risks that can give rise to costly demands and complaints, are nowadays, in opinion of Palmgren (1999), a significant matter to owners, and the evaluation of these and other risks is an essential requirement to maritime trade safety Although risk, inherent to maritime industry, cannot be completely removed (UK P&I Club, 1999; Peek and Rawson, 2000), it can be reduced to acceptable levels through the use of risk management principles. However before putting in practice a risk management plan, the owner must identify, evaluate and prioritize the main existing risks.

On the other hand, several researches (UK P&I Club, 1999, US Department of Transportation, 1999) identify human error as cause of 60 and 80 per cent of maritime accidents, giving us an idea of the importance on maritime safety of quality living conditions on board – related to ship condition and maintenance– and quality of crews – related to crew competence and qualification. Since human factors –trigger of human errors– are the main source of risk in maritime activities, it seems interesting to develop methodologies that allow evaluating quantitatively and qualitatively the real incidence of several human factors over maritime accidents happening with the aim of taking human factors into account in properly developing risk management plans.

a) Statement of the Problem

Maritime activity is, without any doubt, a risky activity, and maritime disasters, that had happened through the years and which will happen in an inevitable way, are due to the complex environment of ship operation. Although maritime transport has a relatively low death and injury rate –180 estimated fatalities in 1995, against 45000 fatalities in road accidents happened the same year in the European Union–, the consequences of an accident happening are sometimes far reaching. The repercussions of oil pollution or large loss of life in a passenger carrying vessel, can reverberate for many years and take their toll on businesses, small economies and even governments (European Transport Safety Council, 2001a).

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On the other hand, and such it is indicated by Caridis (1999:11) "despite the significant advances that have been achieved in recent years in the field of marine technology, the number of maritime accidents that occur on a world – wide basis has not reduced significantly". This is due to, without any doubt, and as it has been shown in several studies, the high proportion of maritime accidents related to human factors– up to 80%.

So, even nowadays, when navigation instruments use new and advanced technologies, human error is generally accepted to be the main cause of such casualties. In relation to this, it is pointed out (Moreton, 1997) the wrong tendency to think that these new and improved technologies and rules can counteract the human limits increasing safety at sea, even when such technologies and rules are frequently developed in an isolated way, instead of being developed in an integrated way as a component of the navigation system.

In that sense, and following the Report on suggestion for the integration of human factors in safety and environmental analysis (Thematic Network for Safety Assessment of Waterborne Transport, 2003), there is a broad agreement that the key means of lessen the human element contribution to accidents will be via safety management, including inspection and training.

b) *Purpose of Study*

The general purpose of the study is minimization of maritime disasters. But specifically, the objectives of the study include;

i. To examine the major causes of maritime disaster.
ii. To find out the effect of maritime disaster to Nigerian economy in particular.
iii. To examine if the duration of maritime disaster influences survival rate.
iv. To find out casualties rate in Maritime disasters
v. To identify the various ways of minimizing maritime disasters

c) *Research Question*

Based on the specific objectives of the study, the following research questions were highlighted;

i. What are the major causes of maritime disasters?
ii. What are the various effects of maritime disaster to Nigerian economy in particular?
iii. Does duration of maritime disaster influences survival rate?
iv. What is the rate of casualties in Maritime disasters?
v. What are the various ways of minimizing maritime disasters?

d) *Significance of the Study*

This study is important because it focus on transportation. Transportation plays a vital role in the economic and socio-cultural development of any nation. This study is very significant and important to many categories of people, these include to the researcher, maritime transport practitioners, students and future researchers, administrators and policy makers, the government and academicians.

i. *To the researcher*

Although, there are little researches carried out in this area, all so this study is different from other studies because of its unique focus on maritime disaster, hence this research work afforded the researcher the opportunity of providing her with fresh dimension in understanding how the maritime disaster could be minimized.

ii. *To the students*

Students of maritime studies and students of allied studies will in no doubt see this material as a valuable document.

iii. *To the government and policy makers*

Another significance of this study is that, its report will be of great importance to the federal government since it equally highlight the negative implications associated with maritime disaster, hence helping Nigerian maritime sector as a federal agency and pivoting measures of curbing inefficiencies in Nigerian Shipping in particular and Nigerian Maritime sector in general. This research work will in no doubt guide policy makers in their policy and decision making.

iv. *To the stakeholders*

Stakeholders will find this material very valuable and as working document.

v. *To future researchers*

Moreover, the contribution of this study to knowledge can be seen in the sense that it will serve as a framework (both theoretical and empirical) for further research into the subject matter thereby filling an academic gap in the literature maritime disaster.

vi. *To the general Public*

This will help enlighten the general public about the various maritime accidents for over the years.

Finally, a rigorous research of this nature, culminating in concrete conclusions and recommendations will no doubt help to provide fresh dimensions for understanding the performance of public enterprises in Nigeria.

II. Literature Review

a) *Conceptual Framework*

The maritime transport system is a very complex and large-scale (Grabowski et al., 2010) socio-technical environment (STE) system comprising human and man-made entities that interact with each other and operate in a physical environment (Mullai, 2004). The main elements of the system are objects of transport, means of transport, infrastructures, and facilities, which are linked by the information system and transport-related activities. The human is a very important element that designs, develops, builds, operates, manages, regulates, and interacts with other elements of the system.

i. *Accidents, risks and risk analysis*

In essence, the concept of risk is defined as the likelihood of consequences of undesirable events (Vanem and Skjong, 2006; Hollnagel, 2008). Accidents and incidents are negative outcomes of the systems. The terms “marine accident and incident” and “marine casualty” denote undesirable events in connection with ship operations (IMO, 1996). An accident is an undesired event that results in adverse consequences, for example injury, loss of life, economic loss, environmental damage, and damage to or loss of property (Harrald et al., 1998; Grabowski et al., 2010). Accidents are due to an unexpected combination of conditions or events (Hollnagel et al., 2006).

ii. *Reason s why Maritime Accidents Occur*

Research and statistics show that human error is to blame in over 70% of marine accidents. Maritime accident occurs due to;

- Trips and falls,
- fire,
- pollution and collisions,
- failure in safe working practices.

Incidents most times result in crew injuries or fatalities, also the ship is being consequently delayed or damaged.

Consequently, when there is a mechanical failure, human error can play a role either by way of a lack of maintenance, monitoring, inadequate or lack of suitable equipment or protective devices, as well as breakdown in communication or procedures.

iii. *Manning Issues*

Crew fatigue and complacency can often be a major factor in incidents. The prudent ship owner or manager will ensure that these are addressed by way of additional manning or rotating the ship staff more regularly if the ship is employed on a demanding trade route.

However, owners and managers who are unable to do this could be due to; shortage or unavailable trained seafarers as a result of commercial or operational considerations.

Therefore good equipment can cost more, but safety should be accorded a higher priority, because a ship cannot be operated safely without the seafarer.

iv. *Ship Design*

Ship design is carried out by man and most times could have very little practical knowledge of the designing. However, in the modern world of shipbuilding, ship design team most times integrates the propositions of seafarers who are familiar with or may have sailed on the type of ship that is being designed.

Also proper supervision in ship building process ensures that discrepancies and potential problem areas are addressed. Highly skilled officers are also able to join the ship during the final fitting-out process in order to familiarize themselves with the ship.

vi. *Operating Standards*

Improved methodology in ship design does not completely address the problem, as the seafarer then has to decipher the operating manuals that are supplied with the equipment. The Confidential Hazardous Incident Reporting Programme (CHIRP) has recently concluded a study, with the help of the UK’s Marine Accident Investigation Board, which shows that a substantial number of accidents are caused by operating manuals that are hard to understand.

Language can often be a major problem. The manual may not be written in the language of the crew on board, and is often merely a generic document. Given that adequate facilities are available for translation of manuals into just about any language, this is unacceptable.

vii. *Lack of Unified Standards*

Equipment problems are further compounded by the lack of a unified standard for essential equipment, including oily water separators, voyage data recorders and lifeboat launching equipment, and until regulatory and industry bodies are able to agree on a common standard, it is the seafarer who will be faced with understanding and operating equipment that is unfamiliar and unduly complex, often in less than ideal conditions.

b) The theoretical Framework

The key definitions and concepts relevant to model design are the maritime transport system, risks, risk analysis, and accident modeling.

The maritime transport system The maritime transport system is a very complex and large-scale (Grabowski et al., 2010) socio-technical environment (STE) system comprising human and man-made entities that interact with each other and operate in a physical environment (Mullai, 2004). The main elements of the system are objects of transport, means of transport, infrastructures, and facilities, which are linked by the information system and transport-related activities. The human is a very important element that designs, develops, builds, operates, manages, regulates, and interacts with other elements of the sys-tem. Individuals, groups, their relationships, and communication constitute organizational systems. These elements are embedded in very complex, interdependent, and dynamic relationships.

Accidents, risks and risk analysis In essence, the concept of risk is defined as the likelihood of consequences of undesirable events (Vanem and Skjong, 2006; Hollnagel, 2008). Accidents and incidents are negative outcomes of the systems. The terms "marine accident and incident" and "marine casualty" denote undesirable events in connection with ship operations (IMO, 1996). An accident is an undesired even that results in adverse consequences, for example injury, loss of life, economic loss, environmental damage, and damage to or loss of property (Harrald et al., 1998; Grabowski et al., 2010). Accidents are due to an unexpected combination of conditions or events (Hollnagel et al., 2006). Risk analysis is the systematic use of available information to identify hazards and estimate the risk to people, the environment, and property (Mullai, 2004; Lars Harms-Ringdahl, 2004). In order to understand risks, risk analysis attempts to provide answers to three fundamental questions: "What can go wrong?" "What are the consequences?" and "How likely is that to happen?" – known as the "triplet definition" of risk (Kaplan et al., 2001). These questions can lead to other questions, which, in turn, require additional answers and efforts. Risks can also be measured as a combination of consequences relative to the number of risk receptors exposed to the undesirable events. This form of risk estimation has become a legal requirement in several countries (OECD, 2004). Thus, the risk can be expressed as a function (f) of frequency, consequence, and exposure (Eqs.(1) and (2)) (Mullai, 2007).

$$Ri=f(Fi,Ci,Ei) \quad (1)$$

$$Ri=f(Fi,Ci) \quad (2)$$

Where: Ri– individual, societal, and aggregated risks. The latter are compounded human risks (fatality, injury, and other health risks), environmental risks, property risks, and other risks.

Fi– frequency– likelihood, probability;

Ci– consequences for risk receptors, i.e. human, the environment, property, and other, e.g. disruption and reputation.

Ei– exposure, i.e. the number and categories of risk receptors exposed to but not necessarily affected by the undesirable events.

By definition, the concepts of risk and risk analysis have a wider scope than those of accident and accident analysis. The accident is a constituent element of the risk. Risk analysis encompasses a wider range of processes than accident analysis, including exposure analysis and risk estimation and presentation Accident models Different terms are used to describe accident phenomena as well as analysis tools, for example approaches, techniques, frameworks, methodologies, methods, and models. The term accident model isfrequently used in the literature (Leveson, 2004; Grabowski et al.,2000; Nikolaos et al., 2004; Laracy, 2006).

Accident analysis, which always implies an accident model (Hollnagel, 2002), is a very important process for providing inputto the development of proactive and cost-effective regulations (Psarros et al., 2010). An accident model is an abstract conceptual representation of the occurrence and development of an accident; it describes the way of viewing and thinking about how and why an accident occurs and predicts the phenomenon (Huang et al., 2004; Hollnagel, 2002). Hollnagel (Hollnagel, 2002; Hollnagel et al., 2006) divide accident models into three main types, namely Sequential, epidemiological, and systemic and functional. Each type consists of a set of assumptions on how the reality is viewed and how accident analysis should be performed and the theoretical foundation and limitations (Hollnagel, 2002; Hollnagel et al., 2006). Epidemiological accident models describe an accident as the outcome of a combination of factors. Such models are rarely strong, as they are difficult to specify in great detail. Systemic accident models consider accidents as emergent phenomena and are based on control theory, chaos models, stochastic resonance, and systems approach.

In the latter, the system is viewed as a whole rather than individual components or functions. Systemic models are difficult to represent graphically (Hollnagel, 2002; Hollnagel et al., 2006). Most accident models are sequential viewing accidents as a sequential chain of events that occur in a specific order (Harraldet al., 1998; Hollnagel, 2008; Leveson, 2004; Nikolaos et al., 2004; Van Drop et al., 2001; Özgecan and Ulusc u, 2009; Celik et al., 2010). Three typical sequential models, namely the Bowtie model, Swiss cheese model, and a framework for maritime risk assessment.

c) Empirical Framework

A work on A Maritime Disaster: Reactions and Follow-up by Atle Dyregrov and Rolf Gjestad in 2003. In 1999, 69 people survived a maritime disaster on the Norwegian coast, during which 16 others died. Besides immediate psychosocial assistance, post-disaster intervention included psychological debriefings after one week, follow-up debriefing a month later, screening of those in need of individual help, and help for those returning to the scene of the disaster. The results of the psychometric tests showed that a considerable number of survivors scored above clinical cut-off points for extreme stress reactions. These results were compared with results from other studies of maritime disasters. Although the life threat and exposure in this disaster were extreme, the scores were lower than for the other studies, with one exception. The authors concluded the lower distress scores compared to other maritime disasters were probably impacted by the structured and caring system that was implemented to care for survivors. Almost all (93%) considered the debriefing meetings as helpful, and they were able to discriminate between different functions served by the meetings.

A significant portion of survivors of disasters experience symptoms of posttraumatic stress disorder (PTSD) (Bolton, O'Ryan, Udwin, Boyle, & Yule, 2000;

Briere & Elliot, 2000; Yule, Bolton, Udwin, Boyle, & O'Ryan, 2000). In a meta analysis of 52 studies examining the mental health consequences of natural and technological disasters, Rubonis and Bickman (1991) found rates of psychopathology increased by 17% compared with predisaster or control-group levels. Given the diversity of disasters, both manmade and natural, no unitary PTSD prevalence would be expected. Systematic reports on survivors of shipping disasters are rare, although observations and case reports are abundant. When the Italian ships *Andrea Doria* and the Swedish ship *Stockholm* collided outside of Massachusetts in 1956, two psychiatrists were on board one of the ships that came to the rescue. Friedman and Linn (1957) describe how the passengers behaved as if they were numb from being injected by medication. The psychiatrists viewed their helplessness as an emotional regression. They were in shock and any attempt at conversation was impossible before the shock reaction lifted. They had a need to tell their story again and again, afterwards. Leopold and Dillon (1963) studied 27 of 35 survivors following a ship collision and explosion and found that 72% suffered from emotional disturbances following the disaster. When they again studied the group four years later, there was a dramatic degree of physical, psychological, and social aftereffects from the disaster. One of the first maritime disasters to be studied in any detail from a psychological perspective was the capsizing of the ferry *Herald of Free Enterprise* outside of the Belgian city of Zeebrügge in 1987. Joseph, Yule, Williams, and Hodgkinson (1993a) studied 73 adult survivors, two to three years after the disaster and found the mean Impact of Event Scale (IES) score to be 35, while the mean score on the General Health Questionnaire (GHQ-28) was 10. On the GHQ more than 66% scored above the cut-off score of > 4 that indicates a risk of a psychological disturbance. The same research group also documented different forms of guilt feelings among survivors (Joseph, Hodgkinson, Yule, & Williams, 1993), as well as an increase in the use of alcohol, tobacco, sleeping pills, antidepressants, and tranquilizers (Joseph, Yule, Williams, & Hodgkinson, 1993b). Joseph, Andrews, Williams, and Yule (1992) studied crisis support and psychiatric symptomatology in 23 adult survivors following the sinking of the cruise ship *Jupiter* off the cost of Athens in October 1988. The survivors' mean IES score when assessed 3 to 9 months following the disaster was 32.3. After 12 to 14 months, the IES score was 29.9. On the GHQ-28, the respective scores at the two time points were 12.6 and 8.9. The authors also found that perception of greater crisis support was related to less symptomatology. The same research group also studied adolescent survivors of the same disaster. To date, this is one of the few longitudinal studies of a maritime disaster. Yule, Bolton, Udwin, Boyle, O'Ryan, and Nurrish (2000) have shown that approximately 50% of adolescent survivors of the *Jupiter* disaster developed PTSD sometime during the follow-up period compared with an incidence of 3.4% in a control group. Between five and eight years after the disaster, 34% of these still suffered from PTSD. In another English study, Thompson, Chung, and Rosser (1994) studied the reactions of 27 survivors following the collision and sinking of the riverboat *Marchioness* on the Thames. Fifty-one persons in a birthday party drowned and 40 survived. Of the 27 survivors studied, 22 were men with a mean age of 28. Their mean IES score was 46 and the GHQ-28 mean was 15.5 when they were assessed more than one year following the disaster. The survivors knew those who were killed, and 25 of the 27 had lost close friends. Elklit and Bjerre Andersen (1994) studied 24 of 31 Danish survivors following the fire on board the ferry *Scandinavian Star* in 1990 where 159 people died. Their mean IES score 1½ years after the disaster was 23.0 and after three years, the score was 21.7. The group generally received much crisis support from Danish Red Cross in the early period following the disaster. It should be mentioned that most survivors escaped safely into the lifeboats without being exposed to either fights for survival or the sight of the people that were killed. The largest maritime disaster in the Northern hemisphere in modern times was the sinking of the *Estonia* in the Baltic Sea in 1994 where 852 died and 137 survived. Eriksson and Lundin (1996) studied 42 of the 53 Swedish survivors three months following the disaster and found their IES score to be 28.5. The survivors reported fairly high levels of dissociative symptoms in the form of reduction of awareness, derealization, depersonalization, and dissociative amnesia during the disaster. This peritraumatic dissociation was related to more post-traumatic symptoms on the IES. There is no standardized way of helping survivors in the aftermath of disasters. A range of disaster interventions has been described by authors such as Hodgkinson and Stewart (1991), Dyregrov (1992), and Raphael (1986). In Norway, psychosocial disaster intervention has been used since the mid- 1980s to assist the bereaved and survivors (Dyregrov, 1992). Early intervention is emphasized to try to prevent the development of adverse reactions. Following several Scandinavian disasters, the lack of long-term follow-up to secure good help for those who have survived or lost family members has been identified (Dyregrov, 2002; SOU, 1999). Although early intervention is debated (Shalev, 2000 and *Advances in Mind Body Medicine, No. 3*, 2001), there is no alternative to treating survivors with a caring system. Proactive post-disaster service delivery, including screening those in need of further help, is still at a developmental stage. There is also lack of agreement as to the optimal type of screening instruments, and only rarely (McDermott & Palmer, 1999) have screening inventories been used to secure help for those most in need of further follow-up. Both demographic and event-related factors might influence the choice of screening questionnaires. The use of psychological debriefing, or group follow-up after critical incident situations, has been highly debated over the last decade (Raphael & Wilson, 2000). Although the term "debriefing" originally referred to Dr. Jeffrey Mitchell's structured group meetings for emergency personnel responding to critical events, the term debriefing has been used to describe almost any type of intervention initiated after a critical incident event. Though individual and group follow-up has been in use following disasters for several decades, the debate on debriefing is somewhat new. Participants of debriefings usually rate the method as useful and important for them (Carlier, Voerman, & Gersons, 2000; Jenkins, 1996; Robinson & Mitchell, 1993; Turner, Thompson, & Rosser, 1993), but the few randomized studies undertaken have failed to find that "debriefing" makes a difference in the reported symptom level over time. However, these studies and the critics of debriefing (see Rose & Bisson, 1998) have based their criticism mostly upon individual follow-up of patients provided with a one-hour intervention following medical emergencies (burn victims, traffic accidents, and pregnancy loss). There are other flaws in this research as well, as cited by Dyregrov (1998) and Mitchell and Hopkins (1998). More recent documentation using meta-analysis of studies to evaluate group meetings that more rigorously follow the "Mitchell Model" has shown strong and clinically valid effects of this method (Everly & Boyle, 1999). Watchorn (2000 & 2001) has presented data showing that those who take an active part in the debriefing meetings seem to gain most from these meetings and that persons reporting high dissociation (feelings of "standing outside oneself" or "watching oneself from a distance") and a low level of disclosure are the ones at greater risk to experience later problems.

III. Methodology

- *Research Design*

Adopted for this investigation is ex-post facto design. Isan edighi, Josnuwa, Asim and Ekuns (2004:15) pointed out that ex-post factor design in research is the one in which there is a systematic empirical inquiring in which the researcher does not have direct control of independent variables because, their manifestations have already occurred. The ex-post factor design is justified for use in this study because the variables it investigates have no direct control by the researcher.

- *Population for the study*

Though secondary data from Mickel E and Oscar E formed the major base for analysis, the population for the study also consists of all the staff of NPA traffic dept in Lagos, Nigeria

- *Instrument*

The instrument for data collection was the questionnaire. It consists of two sections, A and B. Section A deals with demographic or personal characteristics of the respondents. B deals with item measuring the specific variables used in the research questions. The questionnaire is a close ended type developed on Linkert Scale to elicit information to the respondents on the degree to which the respondents possessed the attributes of variables under investigation. The section B consists of Sub-Sections each handling a particular variable of the study.

a) Data Presentation and Analysis

For the purpose of this research, secondary data were collected to address the research questions, 18 maritime disasters over the period 1852–2011 were compiled and analyzed. The data cover the fate of over 15,000 passengers and crew members of more than 30 different nationalities.

Table 1 : Maritime disasters from 1852 to 2011

Name of ship	Year	Cause of disaster	Water	Nationality	Duration	WCF Order	Casualties	Survivors
HMS Birkenhead	1852	Grounding	Indian Ocean, RSA	British	Quick	Yes	365	191
SS Arctic	1854	Collision	North Atlantic, CAN	US	Slow	Yes	227	41
SS Golden Gate	1862	Fire	Pacific Ocean, MEX	US	Slow	No	206	172
SS Northfleet	1873	Collision	English	Channel, UK British	Quick	Yes	287	80
RMS Atlantic	1873	Grounding	North Atlantic, CAN	British	Slow	No	538	330
SS Princess Alice	1878	Collision	River Thames, UK	British	Quick	No	697	140
SS Norge	1904	Grounding	North Atlantic, UK	Danish	Quick	No	635	160
RMS Titanic	1912	Collision	North Atlantic, CAN	British	Slow	Yes	1,496	712
RMS Empress of Ireland	1914	Collision	St Lawrence River, CAN	British	Quick	No	983	465

RMS Lusitania	1915	Torpedoed	North Atlantic, UK	British	Quick	Yes	1,190	768
SS Principessa Mafalda	1927	Technical	Atlantic Ocean, BRZ	Italian	Slow	No	309	877
SS Vestris	1928	Weather	Atlantic Ocean, USA	British	Slow	No	125	183
SS Morro Castle	1934	Fire	Atlantic Ocean, USA	US	Slow	No	130	412
MVPrincess Victoria	1953	Weather	North Channel, UK	British	Slow	No	135	44
SSAdmiral Nakhimov	1986	Collision	Black Sea, UKR	Russian	Quick	No	423	820
MS Estonia	1994	Technical	Baltic Sea, FIN	Estonian	Slow	No	852	137
MSPrincess of the Stars	2008	Weather	Philippine Sea, PHI	Philippine	Slow	Unkn own	791	59
MV Bulgaria	2011	Weather	Volga, RUS	Russian	Quick	Unkn own	110	76

Source: Mikael Elinder and Oscar Erixson

Duration refers to the time period between the first indication of distress and the sinking. Quick (Slow) implies that the time period was shorter (longer) than 30 minutes. WCF order indicates if the captain gave the WCF (women Children Frist) order.

b) Analysis of Research Questions

Table 2 : What are the major causes of maritime disasters?

Causes	No	Percentage
Grounding	3	16.6
Collision	6	33.3
Fire	2	11.1
Torpedoed	1	5.5
Total	18	100

The above table shows that grounding represents 16.6% of the causes of marine accidents, collision 33.3%, and fire 11.1% while Torpedoed is 5.5%. From the research questionnaire

Table 3 : What are the causes Marine accidents

S/N	RESPONSES	SA	X4	A	X3	D	X2	SD	X1
1	Human factor	8	32	2	6	0	0	0	0
2	Poor education and training	6	24	4	8	0	0	0	0
3	Inadequate policies and procedures	9	36	1	3	0	0	0	0
4	External factors like bad weather	8	32	2	6	0	0	0	0
5	Technical factors like unavailability of advanced equipments like GMDSS	8	32	1	3	1	3	0	0
	Total	39	156	10	26	1	3	0	0

From the above table, it could be deduced that almost all the respondents agreed that the causes of maritime accident include human factor 8 strongly agree and 2 agree, poor education and training 6 strongly agree and 4 agree, inadequate policies and procedures 9 strongly agree and 1 agree, external factors 8 strongly agree and 2 agree and technical factors 8 strongly agree, 1 agree and 1 disagree.

Table 4 : What are the various effects of maritime disaster to Nigerian economy in particular?

Name of ship	Year	Casualties	Survivors
HMS Birkenhead	1852	365	191
SS Arctic	1854	227	41
SS Golden Gate	1862	206	172
SS Northfleet	1873	287	80
RMS Atlantic	1873	538	330

SS Princess Alice	1878	697	140
SS Norge	1904	635	160
RMS Titanic	1912	1,496	712
RMS Empress of Ireland	1914	983	465
RMS Lusitania	1915	1,190	768
SS Principessa Mafalda	1927	309	877
SS Vestris	1928	125	183
SS Morro Castle	1934	130	412
MVPrincess Victoria	1953	135	44
SS Admiral Nakhimov	1986	423	820
MS Estonia	1994	852	137
MS Princess of the Stars	2008	791	59
MV Bulgaria	2011	110	76
Total		**9499**	**5484**

Source: Extracted from table 1

From the above table, it can be observed that death/casualties are one of the effects of maritime disasters. It can also be deduced that materials and cargoes on board the vessel are liable to loss as well.

From the research question,

Table 5 : What are the various effects of maritime disaster to Nigerian economy in particular

S/N	RESPONSES	SA	X4	A	X3	D	X2	SD	X1
6	Collision leads to detrimental environmental effects.	8	32	2	6	0	0	0	0
7	Financial loss to both, the ship owner and the nearby local communities is huge	6	24	4	8	0	0	0	0
8	Ship collision renders substantial threat to human life.	9	36	1	3	0	0	0	0
9	Collision with an offshore structure or a port leads to infrastructure damage and thus cause a heavy blow to human efforts.	8	32	2	6	0	0	0	0
10	Loss of jobs	8	32	1	3	1	3	0	0
	TOTAL	39	156	10	26	1	3	0	0

Source: Researchers

From the above table, it shows that almost all the respondents agreed that the effect of maritime accident include detrimental environmental effects 8 strongly agree and 2 agree, financial loss 6 strongly agree and 4 agree, threat to human life 9 strongly agree and 1 agree, marine structures damage 8 strongly agree and 2 agree and loss of job 8 strongly agree, 1 agree and 1 disagree.

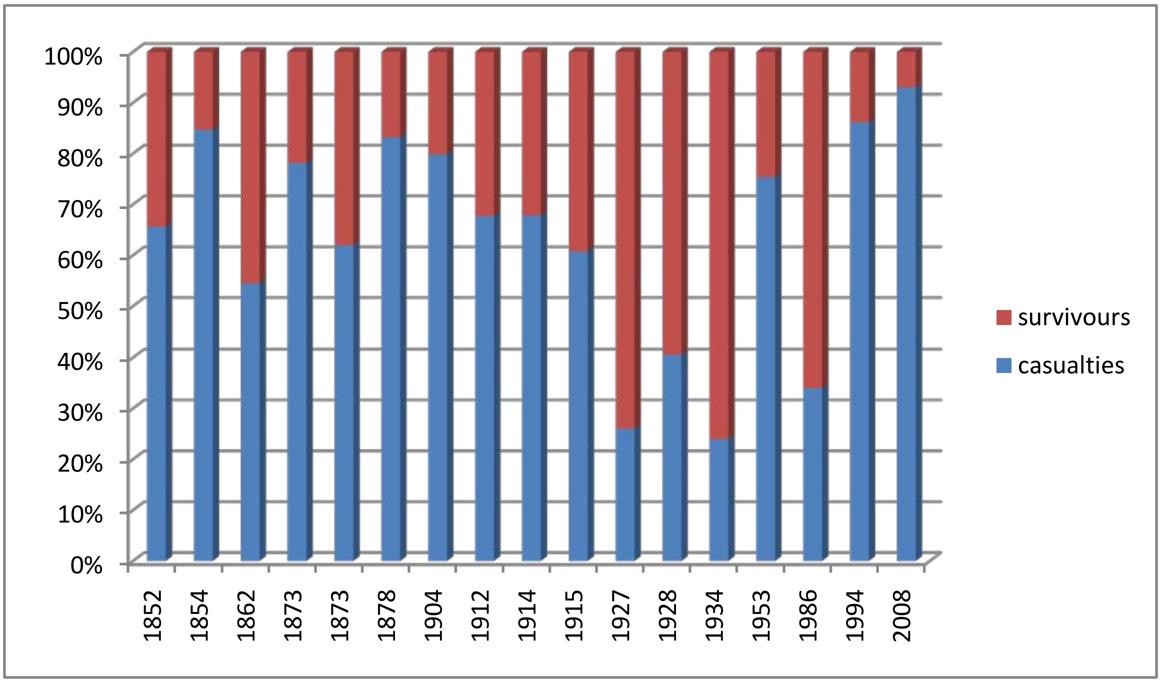
Table 6 : Does the duration of maritime disaster influences survival rate?

Quick	8	Survivors	2700	Casualties	4690
Slow	10	Survivors	2784	Casualties	4809
Total	**18**	**Total**	**5484**	**Total**	**9499**

The above table shows that 8 accident/disaster cases recorded quick duration while 10 accident cases recorded slow duration. The table further show that 2784 survivors were recorded during slow duration of the disaster and 2700 survivors were recorded during quick duration of the disaster. Also 4690 casualties were recorded during quick duration of the disaster while 4869 were recorded during slow disaster duration.

Table 7 : What is the rate of casualties in Maritime disasters?

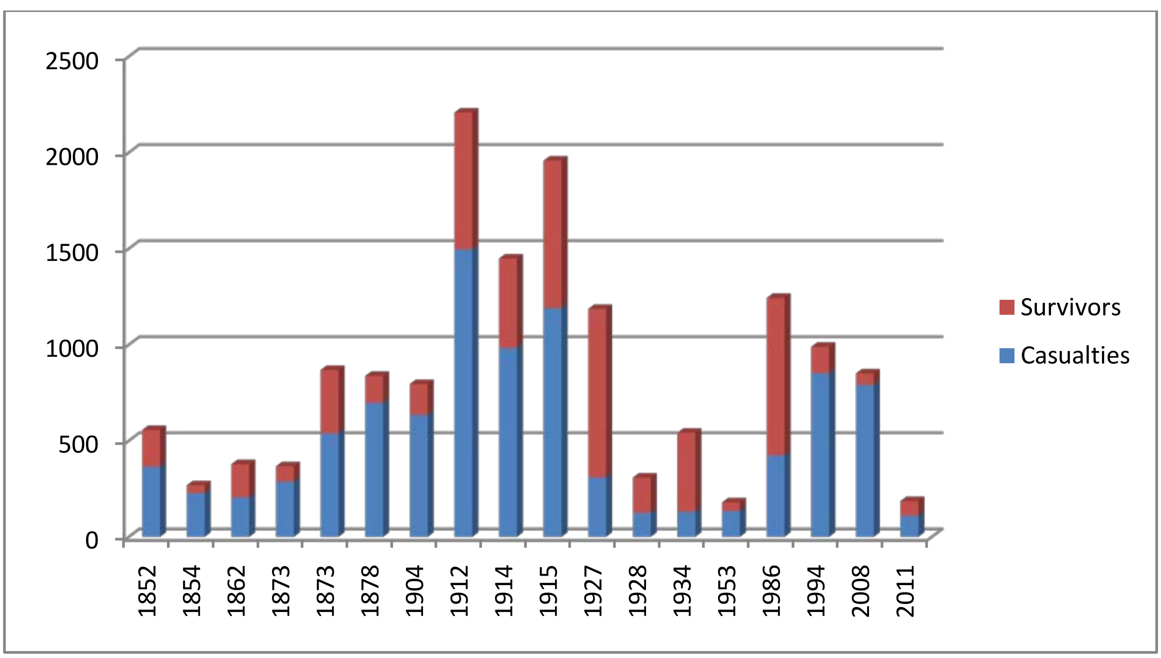
Name of ship	Year	Casualties	Survivors
HMS Birkenhead	1852	365	191
SS Arctic	1854	227	41
SS Golden Gate	1862	206	172
SS Northfleet	1873	287	80
RMS Atlantic	1873	538	330
SS Princess Alice	1878	697	140
SS Norge	1904	635	160
RMS Titanic	1912	1,496	712
RMS Empress of Ireland	1914	983	465
RMS Lusitania	1915	1,190	768
SS Principessa Mafalda	1927	309	877
SS Vestris	1928	125	183
SS Morro Castle	1934	130	412
MV Princess Victoria	1953	135	44
SS Admiral Nakhimov	1986	423	820
MS Estonia	1994	852	137
MS Princess of the Stars	2008	791	59
MV Bulgaria	2011	110	76
Total		**9499**	**5484**



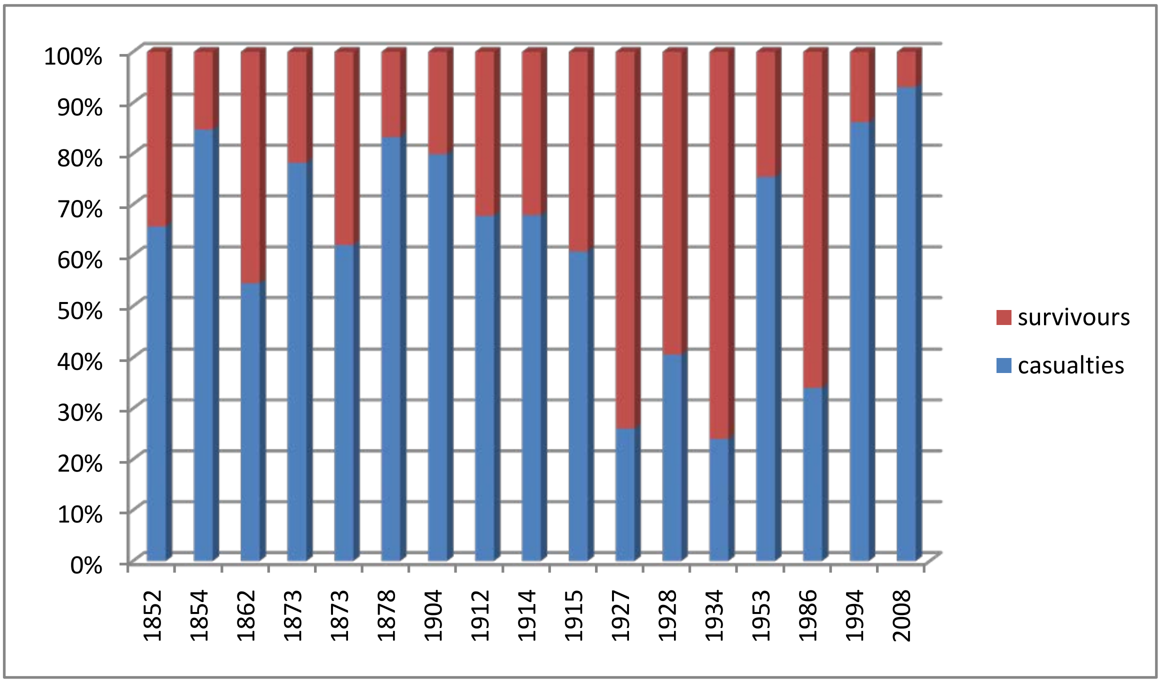
Source: Researchers

The above table and figure shows that the number of casualties and survivors in percentages recorded between the period of 1852 to 2011 of maritime disasters is 9499 of the total of 14903. This figure represents 63.7% of the total passengers and crew members on board.

This could be further analysed using charts as show in fig 1 and 2.



Source: Researchers



Source: Researcher

Table 6 : What are the various ways of minimizing maritime disasters?

S/N	RESPONSES	SA	X4	A	X3	D	X2	SD	X1
1	proper implementation of the latest STCW requirements	8	32	2	6	0	0	0	0
2	Education and training of personnel	6	24	4	8	0	0	0	0
3	Effective compliance to Policies and procedures	9	36	1	3	0	0	0	0
4	Master took the proper measures (such as reduce speed, change course, go to a safe place, send distress signal	8	32	2	6	0	0	0	0
5	Putting in place advanced technology systems that would reduce the risk of accidents	8	32	1	3	1	3	0	0
	Total	39	156	10	26	1	3	0	0

Source: Researchers

From the above table, it could be deduced that almost all the respondents agreed that various ways of minimizing maritime distress include proper implementation of the latest STCW requirements with 8 strongly agree and 2 agree, education and training 6 strongly agree and 4 agree, compliance to policies and procedures 9 strongly agree and 1 agree, Master took the proper measures (such as reduce speed, change course, go to a safe place, send distress signal 8 strongly agree and 2 agree and putting in place advanced technology systems that would reduce the risk of accidents 8 strongly agree, 1 agree and 1 disagree.

IV. Conclusions

This research on minimizing maritime disasters has observed that poor crew competence, lack of communication, lack of proper maintenance, lack of application of safety or other procedures, inadequate training, poor judgment of the situation, and so forth has contributed to more than 80 percentage of marine accidents occasioned by human factor.

It also observed the various consequences of maritime disasters such as threat to human life, lose of job and finance both to the ship owners and the communities, environmental hazards and destruction of maritime facilities among others. The duration of maritime accidents has also been seen as slow in most cases, this means that urgent and quick responses should be in place to salvage lives and properties in case of any mishap at seas.

The study also see education and training of ship personnel as very important which might constitute one of the most important risk reduction measures.

It also noted that training programs that ensure proper implementation of STCW requirements are some of the ways towards achieving this goal. Also training with marine simulators furthers the enhancement of this requirement.

The issue related to technical factors is the central question to what extent accidents might have been averted if the ship had a higher structural strength, a different tank subdivision, or different design characteristics. The central premise behind the new IMO/IACS requirements for bulk carriers and the new IMO/SOLAS requirements for Ro/Ro ferries is that these requirements would enhance safety.

On research question 2 on the effect of maritime accident, if the ship involved in a collision is a tanker or a chemical vessel then there are high chances of the chemical or oil leaking to the sea. Oil spills, both a major and a minor, can lead to untoward conditions for the marine life and also to the nearby coastal areas.

Job loss and financial loss to both, the ship owner and the nearby local communities is huge.

Ship collision renders substantial threat to human life. There has been accidents in past when the ship has sank within minutes, giving no chance to the people on board to escape.

Damage of infrastructures due to collision is a heavy blow to human efforts. Past collisions with bridges and port structures have resulted in heavy financial and efforts loss.

V. Recommendations

This study has been thoughtful considering the implication of the subject matter to the maritime industry and other concern stakeholders.

The following recommendation has been very imperative;

- Considering the causes of maritime disaster as discussed in this research work, the researcher suggest adequate training and full compliance to marine rules and regulations in other to minimize the rate of accidents. Hence emphasis on the existence and establishment of proper policies and procedures should be made.
- There should be adequate training with marine simulators.
- Strict sanctions should be imposed on defaulters.
- The issue with respect to technical factors relates to the possible role of advanced technology systems that would reduce the risk of accidents if in place. This could include highly sophisticated marine equipments like VTMIS, ECDIS, and collision avoidance systems.

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