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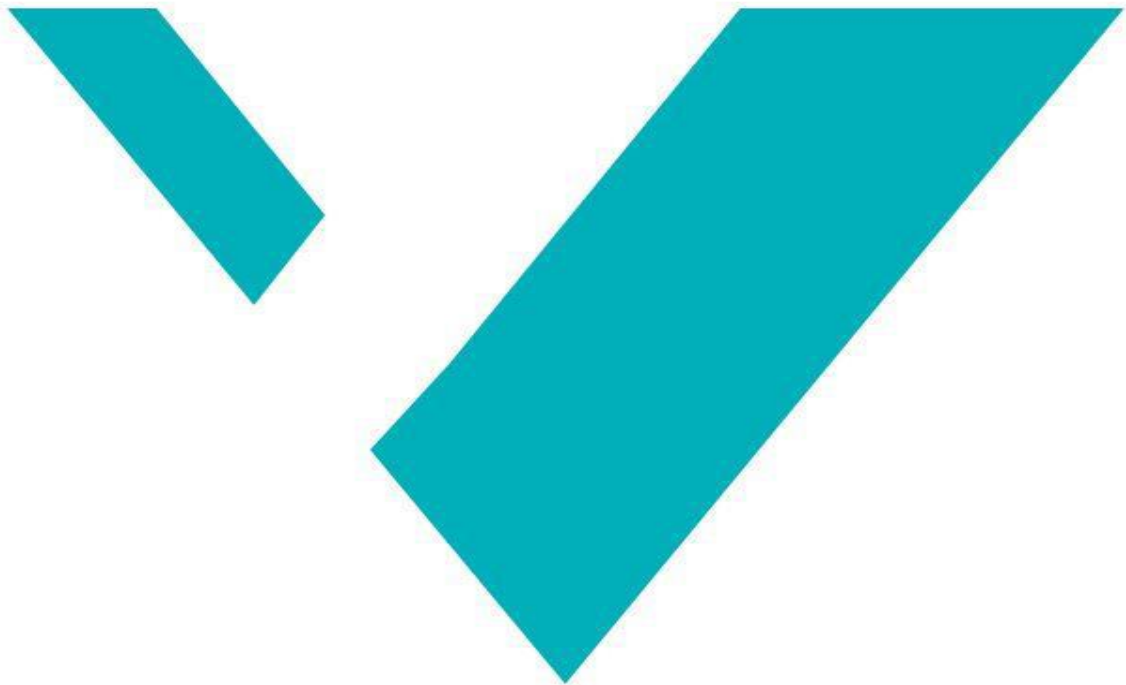
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Maritime Operations



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WESTERN NORWAY UNIVERSITY OF APPLIED SCIENCES

Master Thesis in MARITIME OPERATION

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Preface

This master thesis marks the end of my master's degree in Maritime Operations at the Western Norway University of Applied Sciences, Haugesund. The master's degree is taught at the Department of Maritime Studies at campus Haugesund.

The focus of the thesis has been to understand the procedures and activities that are required to be carried out to maintain the safety integrity level in maritime operations. The procedures and activities are implemented using case studies of Maritime transportation accidents in Congo DRC.

The primary motivation of choosing the topic was to gain an extensive knowledge of the concepts.

Acknowledgement

First and foremost, I would like to thank God so much for giving me strength and wisdom when I felt like giving up. Secondly, I would like to acknowledge the assistance of my thesis supervisor at the university, Professor Ove Tobias Gudmestad, for his valuable advice and intelligent input throughout the execution of thesis. I also had a great pleasure of working with many participants from Congo DRC for providing me with the necessary information. The insightful discussions and guidance on the subject of maritime operation with Professor Ove Tobias Gudmestad have been most important for the success of this thesis.

I wish to also show my gratitude to my family, sepecially my wife Aimee Uwimana and kids, who supported and kept me motivated not only during the execution of this thesis but also during the entire course of my degree.

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Abbreviation

AU	African Union
CAR	Central African Republic
CEMAC	Central African Economic and Monetary Community
CICOS	Commission International du Bassin Congo-Oubangui-Sangha
COLREG	Collision Regulations
DMVN	Direction de la Marine et Voies Navigables/Marine Directorate and Navigable Ways
DRC	Democratic Republic of the Congo
ECDIS	Electronic Chart Display and Information System
ENC	Electronic charts
GMDSS	Global Maritime Distress Safety System
IATA	International Air Transport Association

ICAO	International Civil Aviation Organization
ICLL	International Convention on Load Lines
ILO	International Labour Organization
IMO	International Maritime Organization
ISM	International Management Code for the Safe Operation of Ships and for Pollution Prevention
ISPS	International Ship and Port Facility Security Code
MARPOL	International Convention for the Prevention of Pollution from Ships
OCIMF	Oil Companies International Marine Forum (OCIMF).
ONATRA	Office national des transports (National Office of Transports)
OPRC	Oil Pollution Preparedness, Response and Co-Operation Plan Do Check Act
PDCA	International Convention for the Safety of Life at Sea
PPP:	Public Private Partnerships in Ports
SOLAS	International Convention on Standards of Training, Certification and Watchkeeping for Seafarers
STCW	convention for the suppression of unlawful acts of violence against the safety of maritime navigation (SUA convention)
SUA	convention for the suppression of unlawful acts of violence against the safety of maritime navigation (SUA convention)
TMSA	Tanker Management and Self Assessment

Abstract

Today, maritime transport accounts for the largest part of the world's freight traffic, and significant progress has been made in the maritime industry.

Implementation of safety management gives shipping industries to be successful in their daily operations. The International Management Code for Safety Operation are used and the main objectives of the ISM Code, are to safeguard maritime operations at sea, prevent personal injury and loss of life, avoid damage to the environment, in particular the marine environment. The Tanker Management and Self-Assessment (TMSA) are established to increase safety of maritime operations as guideline to measure and assess tanker operators' management system developed by Oil Companies International Marine Forum (OCIMF).

Maritime transportation in Congo until now is a serious problem due to the lack adequate safety rules and regulations which leads to many accidents every year.

Due to the scarcity of regular company boats, citizens in the Congo DRC resort to motorized canoes or other "whaling boats". Accidents are frequent on the Congo in maritime sector, due to the dilapidated nature of the boats, their overload with passengers and freight and the absence of markings.

In this master thesis, the main objective of research is to collect data and analyse safety transportation system in maritime transportation in Congolese as of today. The transport system of goods (cargo), people and transport system between offshore and onshore in this region will be researched.

Summarize the lessons learned from this research and design a future safety system for the maritime transportation in the Congo DRC and how they can implement a Safety system in their maritime transportation to reduce or eliminate the ever-present deaths and accidents.

Keywords: Transportation, Maritime accident, Human factors, Communications, navigations system, ship hull design, stability and Safety.

I. Introduction

Today, maritime transport represents the largest share of global transport, and there is still considerable growth in the maritime industry.

The key areas of maritime activities include:

- Maritime transport:
- Coastal shipping
- Transport of people both inland and overseas
- International shipping
- Cruise shipping
- Fishing
- Marine farming
- Continental shelf operations (i.e., oil and gas):
- Rig operations
- Supply services
- Pipeline laying
- Underwater activities
- Science and survey

Sea transportation is a big and necessary system in everyday life for human beings. Most important is that maritime transportation is composed of oceans, coasts, seas, lakes, rivers and channels. Marine transportation is a cycle with transport of vessels, sailboat, barge, ship, etc. The requirement for buoyancy joins water vessels and makes the structure's hull a predominant part of its development, maintenance and appearance.

Maritime transport is significantly cheaper compared with air transport. The form for shipping; short sea shipping and ferries are still viable in coastal areas. Below there is a table of characteristics of maritime transport demand

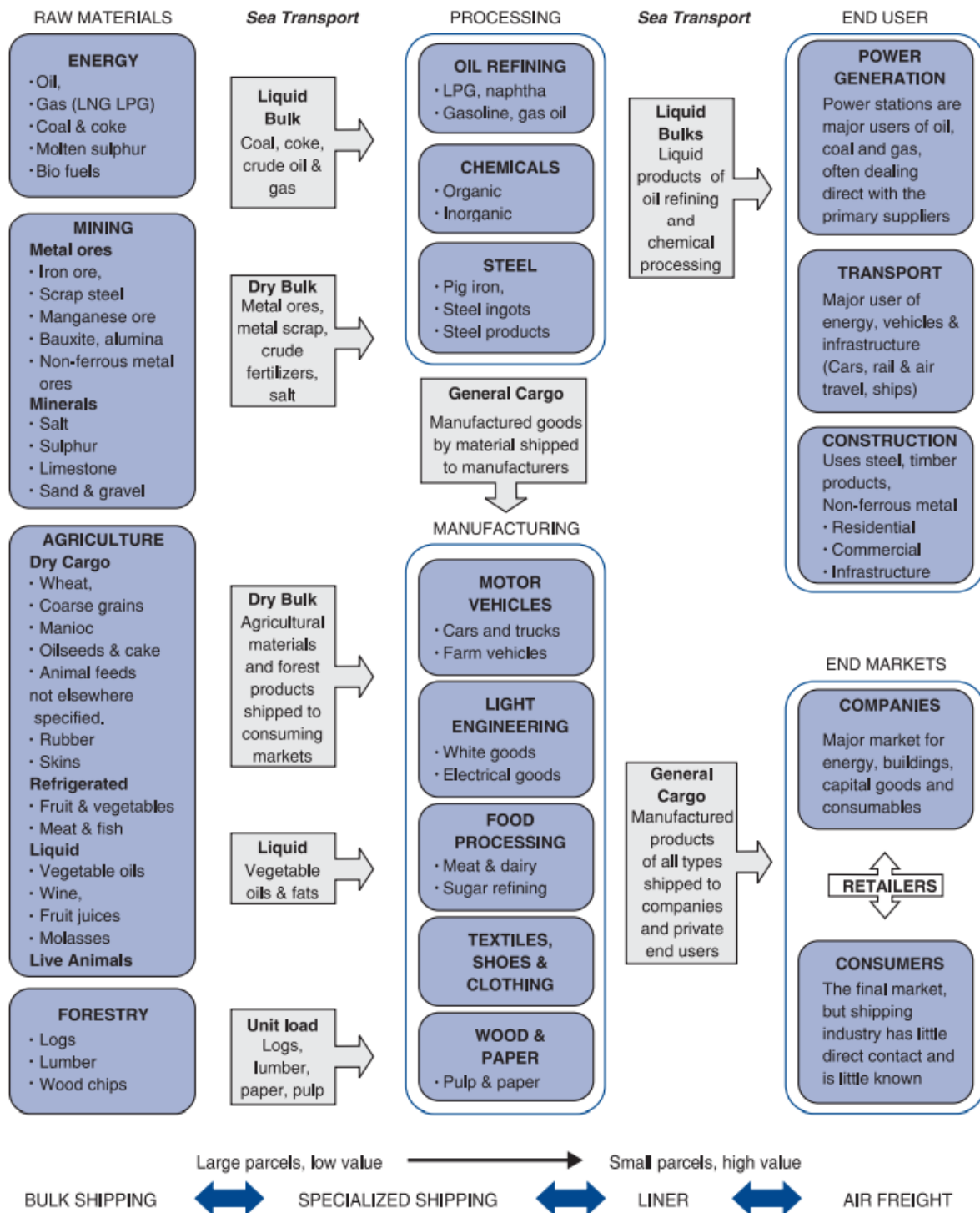


Figure 1: International transport system showing transport requirements [1] . pg. 55

In practice, the maritime framework falls into three groups: between transcontinental locations, which covers long-distance delivery across the sea; dispatch across short seas, which transports loads short distances. In addition, the maritime framework regularly conveys cargoes from external maritime center further inland, which includes the transport on rivers and watercourses.

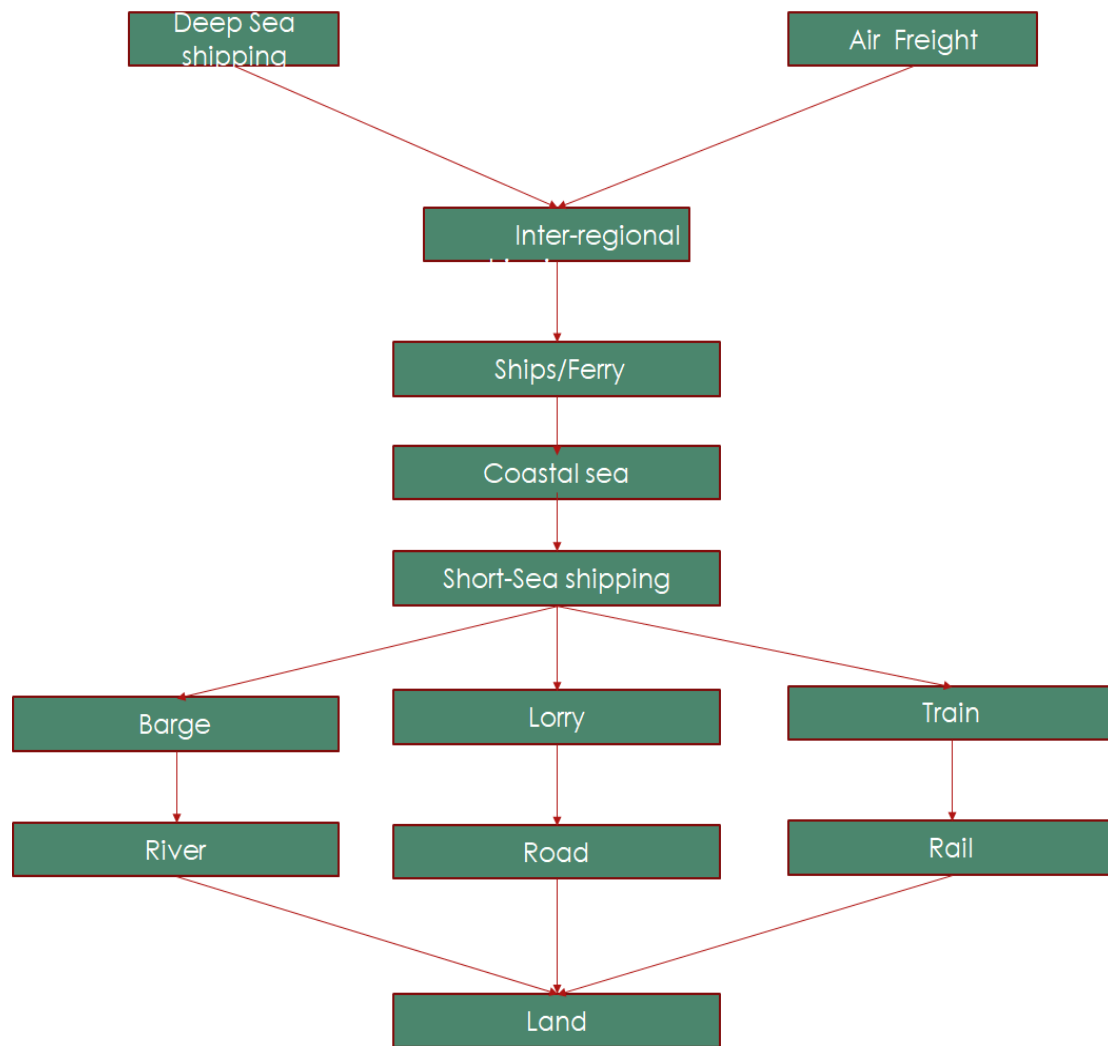


Figure 2: International transport zones and available transport modes [1] Pg.50

Maritime transportation, similar to land and air modes, operates on its own space, which is at the same time geographical by its physical attributes, strategic by its control and commercial by its usage. While geographical considerations tend to be constant in time, strategic, and especially commercial considerations, are much more dynamic. The physiography of maritime transportation is composed of two major elements, which are rivers and oceans. [2] pg.79

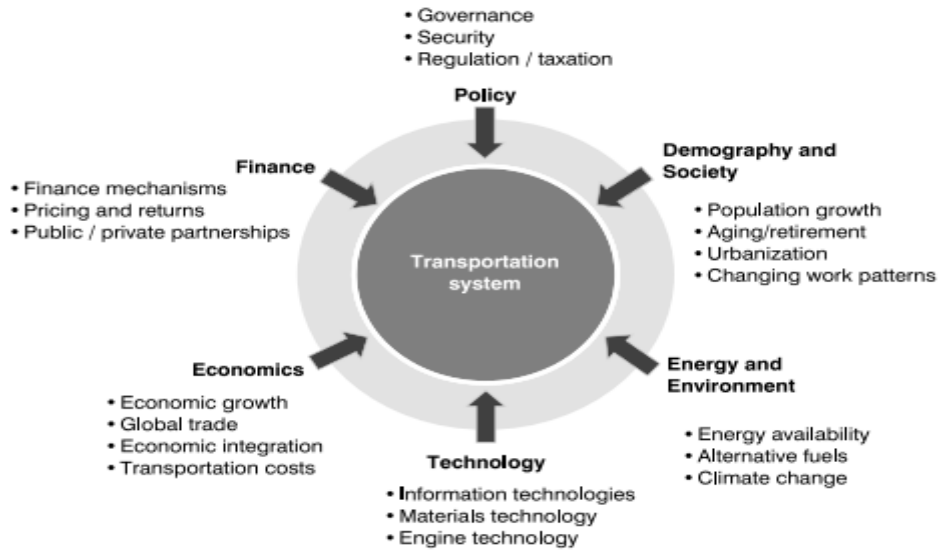


Figure 3: Drivers of change for future transportation [1] pg. 81.

Maritime transportation is the most effective mode to move large quantities of cargo over long distances because the physical properties of water confer buoyancy and limited friction.

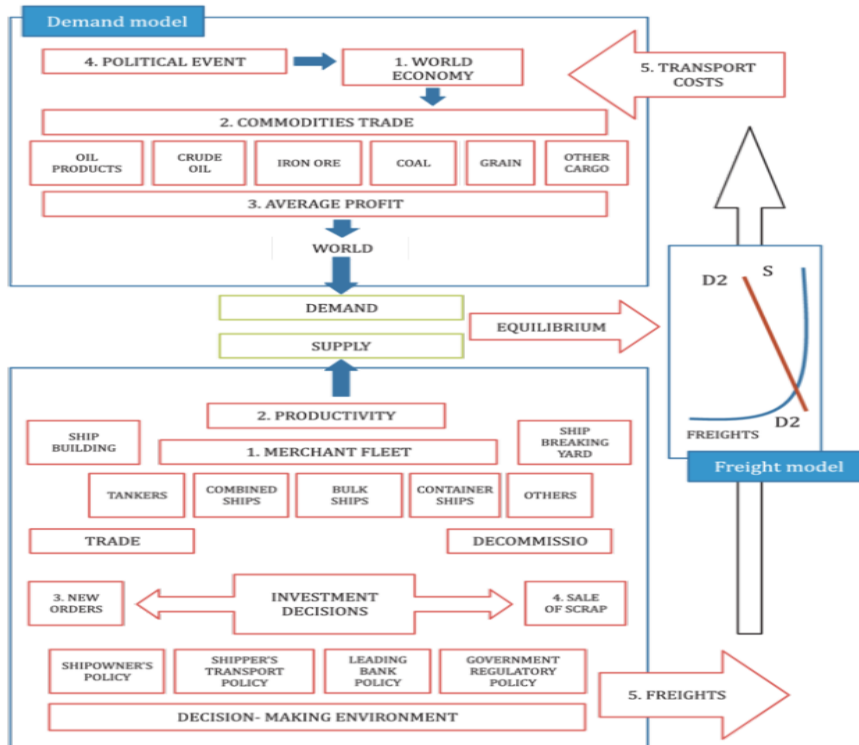


Figure 4: The shipping Market Model [3]. Pg.8

However, due to the location of economic activities, maritime circulation takes place on specific parts of the maritime space. The fundamental benefit of sea transportation is its economies of scale, making it the least expensive per unit

of all transport routines, which fits well for substantial trade operations. and also, naval transportation involves one of the greatest expenses in the transport area. Ordinarily, a boat has a monetary life between 25-30 years and along these lines addresses a huge venture that should be amortized. [2]Pg.96

Safety in maritime sector is crucial because of incidents and risks of marine accidents in maritime transportation. Maritime safety assigns to a high level that will ensure human life and property during watercourse transfer, and the protection of the marine environment. Maritime safety also is a broad term including everything from ship construction to maintenance, and to how professional the crews are. It is always the shipping company's overall responsibility to provide optimal conditions and resources for propelling the ship safely at sea. [4]

This master thesis will document research to analyze maritime safety in Congo DRC by considering operational vessels' navigational safety and reports from marine accidents concerned in Congo DRC.

[I.1. Previous](#)

This research constitutes an instrument of indication to be followed in the field of maritime transport in the Democratic Republic of Congo.

The interest of this research is to analyse the major problems connected to the maritime transport in Congo DRC within the framework of the safety management of risks related to the conditions of travel of people and goods.

Then determine and recommend appropriate measures in order to allow the shipowners and the competent administrative authorities to strengthen the safety level of maritime transport at the provincial and national level to ensure the safety of passengers, property, and goods during the travel in the Congo DRC.

[I.2 Scope](#)

This research aims to identify the possible major risks and incident faced by travellers and goods transporters by civilian vessels navigating through the waters of the Congo DRC. Maritime transportation is the only means of transport and communication linking large towns and villages, the clusters of provinces that touch the Atlantic Ocean and the rivers of the region. Then propose measures for the improvement of safety in maritime transportation system in Congo DRC and standard operating procedures to be adopted by all the stakeholders (like the State Authorities, Shipowners and travellers) in

connection with the national and international maritime, river and lake navigation policies.

This research aims to:

- Identify the level of knowledge of shipowners on maritime regulations that are in force in the Democratic Republic of Congo and the level of their application.
- Identify and characterize the major risks that affect the lives of passengers and the safety of goods in maritime transport routes;
- List the means of mitigating probable fires and emergency rescue assistance put in place by the shipowners, to rescue and secure passengers, and assess their compliance with national and/or international standards.

This research aims to:

- Assess the level of knowledge of shipowners on maritime regulations that are in force in the Democratic Republic of Congo and the level of their application.
- Identify and characterize the major risks that may affect the lives of passengers and the safety of goods in maritime transport routes;
- List the means of mitigating probable fires and emergency rescue assistance put in place by the shipowners, to rescue and secure passengers, and assess their compliance with national and/or international standards.

Statement of Problem

With the increased safety requirements of Maritime Transport legislation in Congo DRC, it is expected that safety in maritime transportation will improve on a high level, the number of maritime victims will reduce significantly, and this will boost public confidence in maritime transport. However, various issues emerge from the maritime activities which bring into light the question of how far and to what extent the safety in maritime transportation legislation will go in improving and ensuring safety in maritime operation in Congo DRC.

Such issues include;

- the applicability of the requirements to the different types of vessels depending on their make, age, and type of cargo,

- standards set by the legislation as regards to the different types of vessels, especially regarding passenger vessels and cargo vessels,
- enforcement of the requirement and legislation and follow up actions against non-complying states, nature, and
- criteria for inspections and review.

As considering these issues, several provisions in the requirements have limited effects and in other cases, there is reluctance in fulfilling the safety requirements.

I.3. Background of the study

I.1.1. Water Transport in Congo RDC

Maritime transportation in Congo RDC is very important because around 2/3 of the country is by navigable waterways and the total length of watercrafts is estimated at 16,238 km including the Congo River. The transport along the coast of the Ocean Atlantic, on rivers and lakes, gives the possibility and ability to navigate and transport goods and people. In Congo RDC, the main maritime transportation is operated on the Congo River with its tributaries and in lake kivu, where those waterways gives the country opportunity to connect the villages with coast areas and the neighbor country.

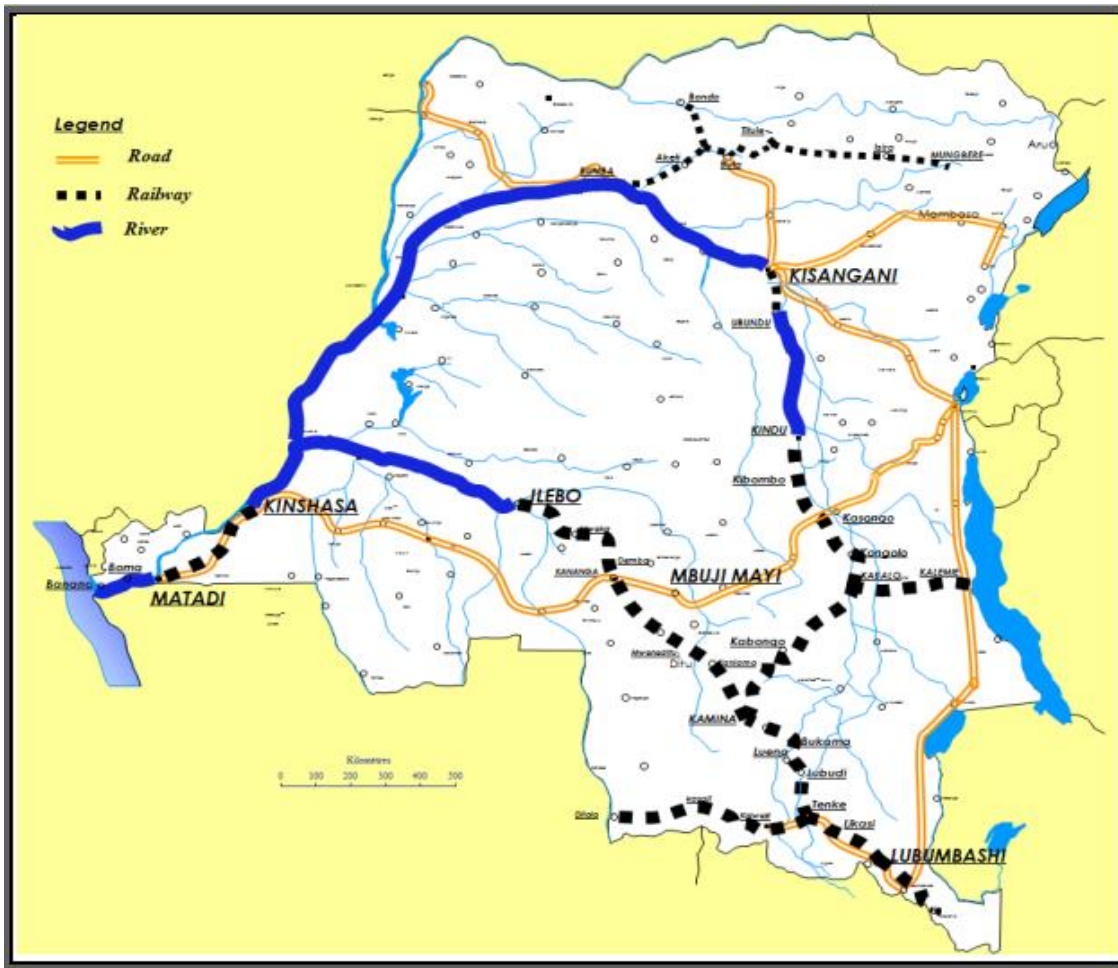


Figure 5: DRC's Main Surface Transport Infrastructure Networks [5] Pg.3

1.1.1.1. Congo River

The Congo River is the second-longest river in Africa, just after the Nile. It is 4,700 km long and finds its source in the village of Musofi in the South Katanga area. It flows into the Atlantic Ocean. With its tributaries the Kasai and the Ubangi, it is accessible to boats and barges to reach almost all the provinces of the DRC. The Congo River courses through 2 large capitals, Kinshasa (Democratic Republic of Congo, DRC) and Brazzaville (Congo Republic), before flowing into the Ocean Atlantic. Downstream from Kinshasa, is Matadi accessible to ocean-going vessels by the maritime reach of the Congo River, Between Kinshasa and Matadi, river navigation is not possible because of the presence of waterfalls and rapids. Because of that, the Congo RDC takes advantage to build the Inga Hydroelectric dam. At Inga, the river drops 102 m in 15 km! The Congo River has a regular regime following the spread of its tributaries in both the northern and southern hemispheres. When it rains in the North, it is the dry season in the South and vice versa. Its flow is the most important in Africa. It is 41,000 m³/ s. [6]



Figure 6: Congo river [6]

1.1.1.2. Lake kivu

Lake Kivu is one of the Great Lakes of Africa. It is located between the Democratic Republic of the Congo and Rwanda, at coordinates $2^{\circ} 03' 44''$ S $29^{\circ} 07' 24''$ E. Lake Kivu empties through the Ruzizi River, which feeds Lake Tanganyika to the south. The lake covers a total area of $2,700 \text{ km}^2$ and is located at an altitude of $1,460 \text{ m}$ above sea level.

Lake Kivu stretches across DR Congo and Rwanda, and has intense activity especially between the towns of Goma and Bukavu on the DRC side (106 km^2). Across the lake, Gisenyi in Rwanda is also very active. Apart from the potential for lake fishing, Lake Kivu also has a strong potential in natural gas production, until present. unexploited on the Congolese side. On the Rwandan side, we note the ongoing exploitation of diluted methane from Lake Kivu, from which electricity is produced through a gas power station. This project was carried out by the American company Contour Global. [7]



Figure 6: Lake Kivu [7]



Figure 7: Sea, rivers and lakes where maritime activities in the Congo RDC take place [8]

The Congo River and its tributaries form a vast network of 25,000 km of waterways. It has a basin of 3.75 million km², which encompasses the territories of 3 countries: the DRC, Congo and the Central African Republic (CAR).

The city of Bangui, the capital of the CAR, is located on Ubangi. It is therefore understandable, the importance of the Congo River in river traffic between the three countries: DR Congo, Congo and RCA.

For the countries' economy, such a center line is essential. If properly operated, it would form the backbone of domestic freight traffic.

Active fishing, which unfortunately has remained at the artisanal stage, is practiced on the Congo River. Congo River has different tributaries, and among its important tributaries, in general in Congo DRC waterways, exist different rivers and lakes as the Kasai river, the Ubangi river in the middle of the northern hemisphere and 2,300 km long, the Sangha 790 km river that crosses Cameroon and the CAR before flowing into the Congo River and the Lukuga which finds its source in the Mitumba Mountains near Kamina and which can be considered as the outlet of Lake Tanganyika.

The Kasai remains the most important tributary. It's totally in the Southern Hemisphere. It has a flow of 12,000 m³/s and is 2,000 km long. It finds its source in the marshes and lakes of

Katanga and flows towards Ilbo and continues to empty into the Congo River. The Kasai has tributaries too as the tributaries of the Kwango, Sankuru, Lulua, Fimi and Kwilu. The Mushie river also discharges its black water from the Mai Ndombe lake into the Kasai. The potential for organizing good river and lake fishing is simply unimaginable! Only goodwill counts to get there. Apart from the river network, the importance of the lakes network in the internal traffic of the DRC should also be noted.

On Lake Tanganyika, dense lake navigation is practiced between the ports of Kalemie in DR Congo, Kioma in Tanzania and Bujumbura in Burundi. The fishing potential is enormous but under-exploited.

The lake network of Lake Tanganyika covers 1,425 km². It links the DRC to Zambia, Tanzania and Burundi.

Let us also mention the lakes Mobutu (ex-Albert) and IDI AMIN (ex-Edouard), that stretch across the DR Congo and Uganda, where lake navigation is not as well structured as in the other lakes but which, like the others, constitute a good reserve of fish which beg to be caught.

Lake Mai Ndombe in Bandundu, with its large town of Inongo, as well as Lake Moero, between DR Congo and Zambia, also remain important in terms of fishing potential.

The Roads are lacking in Congo, therefore, maritime transport where the rivers and lakes are used for transporting goods and passengers are extremely important because help population to reach where cars and planes cannot be reached. [8]

II. Maritime transport standards

The International Organization for Standardization (ISO) defines “Quality” as “the degree to which a set of inherent characteristics fulfils a requirement,” and “requirement” as “a need or expectation that is stated, generally implied or obligatory”. [9] Pg.476.

One of the main goals of international maritime safety regulations is to achieve a satisfactory level of impact in shipping.

It has been highly argued that to achieve improved safety, it's needed for companies to integrate performance of absolute quality in their business plan. It's To crucial to have health, safety and environment (HSE) as a part of the quality notion.

Optimistic way to achieve an elevated quality in manufacture and service is the introduction of international quality level as The International Standards Organization (ISO). [9] Pg.476.

The maritime transport standards are classified as national or international.

II. 1. Maritime Safety waterways transport

Maritime safety is defined as the safety of life, health and property against environmental and operational risks associated with navigation. This concept is broad and its formulation depends on the context and the individual approach. [10] The universal definitions of maritime safety can include the following:

- Freedom from danger,
- No risk, the level of which cannot be accepted, or the lack of harm to human health (freedom from unacceptable risk or personal harm),
- No Financial losses.

Safety can be defined as the state of the marine system such as ship, person, and surroundings in which none of its elements for any given reason threatens any other element of the system. In navigation, the state of danger is caused by a maritime accident, understood as an undesirable event causing significant damage and loss of material and persons as a result of a collision or internally contradictory interactions in the system: man-object-surroundings. [10]

Maritime safety is sometimes defined also as “such desirable conditions of human activity at sea that does not endanger human life and property, and is not harmful to the marine environment”. It is composed of four components namely technological and operational ships’ safety, the safety of navigation, the safety of a person in distress, and prevention of pollution of the environment from ships as shown in Figure 9. [10]



Figure 8: Definition of the term Safety at Sea [10]

It has always been recognized that the best way of improving safety at waterways is by developing international regulations that are followed by all shipping nations.

II. 2. National standards

The have been convention between CICOS/CEMAC with DRC to use waterways their requirement inland water in Congo DRC but also DRC has its own National Code. [11]

II.3. International Standards

IMO’s primary assignment when it came into being in 1959 was to embrace a modern form of the Universal convention for the Safety of Life at Sea (SOLAS), the most essential of all arrangements managing with sea safety. [12]

IMO has created and received worldwide collision controls and worldwide guidelines for maritime farers, as well as worldwide conventions and codes relating to “look and protect”, the help of worldwide maritime operations, load lines, the carriage of unsafe merchandise and tonnage estimation. [12]

The Maritime Safety Committee is IMO’s senior specialized body on safety-related activities.

It is helped in its work by various Sub-Committees:

- Carriage of Cargoes and Containers (CCC),
- Human Element, Training and Watch keeping (HTW),
- Implementation of IMO Instruments (III),
- Navigation, Radio-communication and Search & Rescue (NCSR),
- Pollution Prevention and Response (PPR),
- Ship Design and Construction (SDC),
- Ship Systems & Equipment (SSE)

Navigation controls like the official controls of the International Maritime Organization (IMO) are a fundamental implement for safety on route. [12]

II.3.1. The international convention for the safety of life at sea (SOLAS)

The SOLAS Convention in its subsequent forms is generally regarded as the main important document of all international treaties on the safety of ships' business. The first version was adopted in 1914, in response to the Titanic disaster, the second in 1929, the third in 1948 and the fourth in 1960. The 1974 version contains implied, the acceptance procedure - which stipulates that a change shall take consequence on a specified date, unless exceptions to the change are received from an agreed number of parties before that date. As a result, the 1974 Convention has been updated and amended on several occasions. It was adopted on 1 November 1974 and being admitted on 25 May 1980. [12]

The Convention has been ratified by other nations cross board to Congo. Congo RDC has been called upon to approve the convention. The SOLAS convention points fundamentally at the assurance of human life at sea, endorsing uniform regulations on navigation, anticipation of contamination, stability, equipment, electrical installations, fire avoidance and other perspectives of the development of ships. It too endorses regulations for the safety of routing, amid others. [12]

II.3.2. International Safety Management Code

The ISM Code was adopted on November 04, 1993, within the outline of the IMO and constitutes a managerial/operational approach to sea safety. It came into force from July 01, 1998, concerning passenger ships, oil tankers, chemical tankers, gas tankers, bulk carriers and high-speed vessels with a GRT of more than 500, on worldwide voyages. It got to be required for companies working other types of ships on universal voyages from July 01, 2002. The ISM Code requires a safety administration framework to be set up by the ship proprietor or any individual who has expected obligation for the dispatch. This Code applies globally and represent a recognized standard for the organization of a shipping company's management regarding safety. [9] Pg. 61.

The initiation of the Code implies the setting of the highest necessities for the management of ships. Hence, the require for this code cannot be overemphasized. The code is expecting to address insufficiencies within the organization and management of shipping industries or firm through the foundation of an all-inclusive obligatory code of practice, to guarantee that safety issues are tended to characterize lines both onboard and ashore. Agreeing to Article 1.4 of the Code, it

is up to the shipping company to create, execute and keep up a Safety management framework comprising the company's systems, enlightening and plan strategies for the safety operation of the vessel, procedures of detailing mischances and non-conformities with the code, plan method of preparing for urgent situations as well as for internal audit and management surveys. [13]

II.3.3. Convention on the International Regulations for Preventing Collisions at Sea

This chapter of the SOLAS convention substantiates the regulation dealing with the safety of navigation but the majority of the regulation of navigation is to be found in the 1972 COLREG. On October 20, 1972, COLREG was adopted and entered into force on July 15, 1977. This convention implements the proper regulations of the route. This concerns all vessels upon the seas and in all waters connected with that are navigable by the ships sail into the sea. The Convention has been ratified by the countries around the Congo RDC. The Congo RDC has been called upon to ratify the Convention. [14]

The 1972 Convention was designed to update and replace the Collision Regulations of 1960 which was adopted at the same time as the 1960 SOLAS Convention. [14]

One of the main important conceptions in the 1972 COLREG was the recognition given to traffic separation schemes - Rule 10 gives guidance in determining safe speed, the risk of collision, and the conduct of vessels operating in or near traffic separation schemes. The first such traffic separation scheme was established in the Dover Strait in 1967. It was operated voluntarily at first but in 1971 the IMO Assembly adopted a resolution stating that observance of all traffic separation schemes is made mandatory - and the COLREG makes this obligation clear. [14]

The COLREG includes 38 rules divided into five sections: Part A - General; Part B - Steering and Sailing; Part C - Lights and Shapes; Part D - Sound and Light signals; and Part E - Exemptions. There are also four Annexes containing technical requirements concerning lights and shapes and their positioning; sound signaling appliances; additional signals for fishing vessels when operating in close proximity, and international distress signals. [14]

II.3.4. The International Convention on Load Lines, 1966

The international Convention on Load Lines (ICLL) was adopted on 5 April 1966 and entered into force on 21 July 1968. [15]

The ICLL 1966 applies to all maritime transportation vessels over a certain tonnage, as well as tankers. [15] The Convention has been ratified by neighboring countries but Congo RDC is yet to ratify the Convention. Article 4 of the ICLL 1966 gives that the Convention will apply to ships registered in countries, the governments of which are contracting governments, as well as ships acting in international sailing. [16]

In the same Convention, Article 5 entails that new ships under 24 meters in length and existing vessels under 150 tonnes gross are exempt from use. The provisions of the Convention apply to the ship's cargo limits, and its purpose is to avoid overloading which will lead to losses. It has presently been accepted that limitations on the draft to which a ship can be loaded make a remarkable contribution to her safety. These boundaries are given in the form of freeboards, which in addition to

external weatherproof and watertight integrity constitute the main objectives of the Convention. [16]

The requirements take into proceeding the capability risks that are available in different areas and different seasons, as given in Annex II. The technical appendix contains different extra safety legal actions regarding doors, release ports, hatches, and other objects. The most important goal of these legal actions is to guarantee the watertight integrity of the ship's hull under the freeboard deck. All allowed cargo lines must be stamped amidships on each side of the ship, practical with the deck line. Ships aiming for the transport of timber deck merchandise are apportioned a smaller freeboard as the deck merchandise keeps safe in order to avoid the stun from waves. [15]

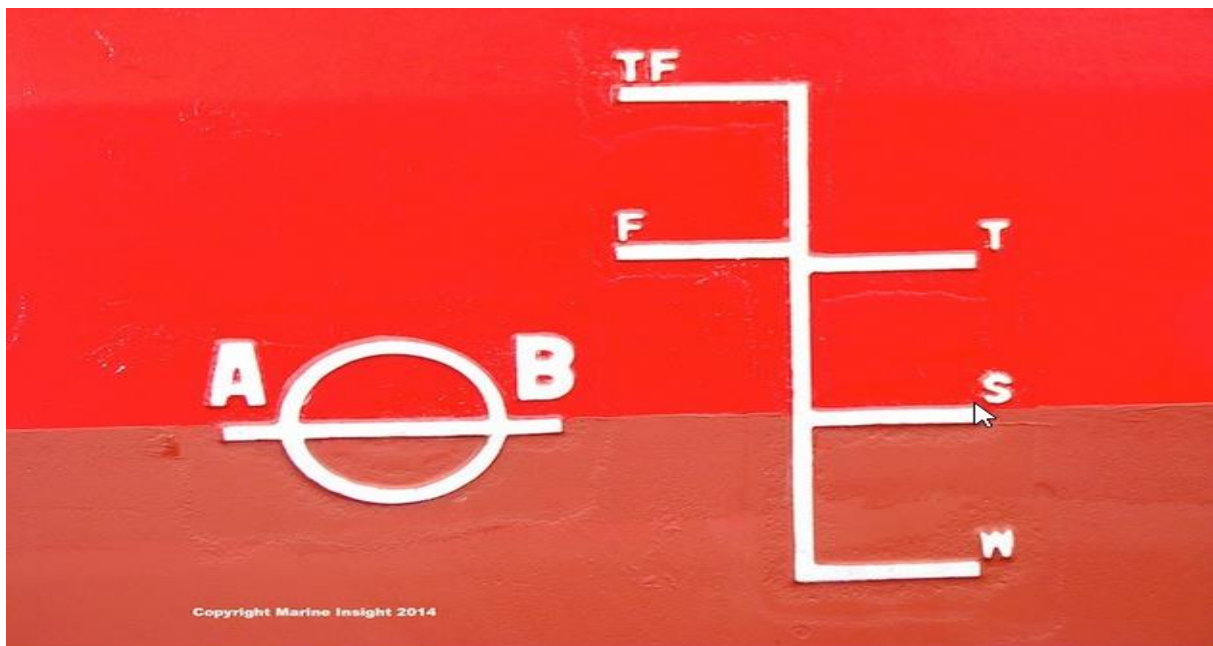


Figure 9:vessels Load Line [17]

The 1988 Protocol, adopted in November 1988, entered into force on 3 February 2000, and the 2003 amendments adopted in June 2003 entered into force on 1 January 2005. [15]

II.3.4. International Convention on Standards of Training, Certification and Watchkeeping for Seafarers (STCW)

Collaboration of IMO and ILO gave the result of the STCW Convention, as it was adopted on July 07, 1978, and came into force on April 28, 1984. The Congo RDC has been inquired to approve the convention. This was the primary Convention to set up basic requirements on training, certification, and watchkeeping for seafarers on a worldwide standard. This Convention requires minimum standards of training, certification, and watchkeeping for seafarers that nations are required to complete. [18]

Part A of the Code is obligatory whereas part B is suggested. Another main modification was the demand for parties to the convention to give necessary

information to IMO regarding management values assumed to make sure that the Convention's agreement followed. [18]

This convention represented for the primary time that the IMO had been asked to take action regarding implementation. Overall implementation is the responsibility of the flag States, while port State control also serves to guarantee compliance. [18]

The section of the STCW Code supports the rules of the Convention. Overall, the Convention contains basic requirements which are then extended and explained in the Code. Part A of the Code is obligatory. The minimum requirements for competence required for seafaring personnel are provided in detail in a number of tables. Part B of the Code holds suggested instructions to assist the Parties in implementing the Convention. [18]

Illustrations are provided to demonstrate how certain convention requirements can be met. Still, the suggestions illustrate an approach that has been harmonized by dialogs inside the IMO and discussions with other international organizations. [18]

The Manila revisions to the STCW Convention and Code were adopted on 25 June 2010, representing a significant amendment of the STCW Convention and Code. The 2010 corrections were applied to enter force on 1 January 2012. [18]

II.5. IMO in the Africa Region

IMO operates in 48 sub-Saharan African countries. IMO has three regional presence offices located in Abidjan (Côte d'Ivoire), Accra (Ghana) and Nairobi (Kenya) based on Memoranda of Understanding signed between IMO and the host Governments. The DRC is under the Côte d'Ivoire IMO headquarter, together with other countries as shown in the figure 11. [19]

Benin	Congo	Mali
Burkina Faso	Côte d'Ivoire	Mauritania
Cameroon	Democratic Republic of the Congo	Niger
Central African Republic	Gabon	Senegal
Chad	Guinea	Togo

Figure 10: Countries under the Côte d'Ivoire IMO headquarter

On the waterways of the African continent, there is a serious lack of effective safety regulations for ships operating on the African rivers, sea and inland waterways. IMO in cooperation with the African Union (AU) developed safety regulations for River and Inland-waters ships and non-convention crafts, as well as fishing vessels, operating in African waters. [19]

IMO has taken part effectively in collaboration with the African Union within the improvement of the 2050 Africa Coordinates Oceanic Procedure (2050 Point Procedure). The 2050 Point Methodology was created as an apparatus to address Africa's oceanic challenges for maintainable improvement and competitiveness. [19]

In article 4 of the introduction, these rules give a territorial safety and pollution prevention level for new ships and barges and, as appropriate, existing ships and assembly-sized ships that consistently and every time navigate in maritime routes of Africa and at sea on worldwide trips, and for the staff who serve them.

Pursuant to Articles 5 and 32, these rules aim to facilitate the performance of ships in which the relevant international agreement do not apply, but in which the application of the basic safety principles included in those agreement should apply; if used, it will guarantee a high level of safety for vessels and people onboard and safety for the marine environment. [20]

Such essential standards include standards for certification and surveys, construction and equipment, freeboard and stability, machinery and bilge pumping arrangements, electrical installations, fire protection, life-saving arrangements and appliances, communications equipment, the safety of navigation, health and safety in the crew's accommodation and working stations, carriage of cargos and dangerous goods, certificates of competency

and manning, pollution prevention as well as fishing vessels as given respectively by the Model Safety Regulations. [12]

III. Marine Accidents In The Democratic Republic Of Congo (DRC)

III.1. Accidents in the maritime transportation sector in general

People will implement safety in maritime operations to minimize as much as possible the injury caused by an accident from an unsafe act or failures of a human being or a technical system.

An accident is characterized as an undesirable occasion that causes harm to people, resources and /or the environment. **Invalid source specified.**, Page 19.

There are three different varieties of consequences in maritime accidents:

- Harm to human beings: injuries and fatalities.
- Environmental pollution
- Economic losses: injury or loss of vessel and cargo, lost financial gain, etc. **Invalid source specified.**, Page 20.

The research on maritime failures contribute to the recognition of the nature of vessels' accident mechanisms related to systems or functions. There exist different hazards in different sectors of Maritime operations as shown in the table 3.1 below:

Table 1 Different maritime sectors and possible Hazards

Maritime sector	Hazard
Shipping and personnel transport	<ul style="list-style-type: none"> • Dangerous cargo: fire, explosion, poisoning, environmental damage • Ocean environment and weather • Substandard ships and substandard ship-owners • Difficult to control safety due to its international character
Fishing	<ul style="list-style-type: none"> • Relatively small vessels with critical features (e.g., hatches) • Ocean environment and weather • Operation in coastal waters – grounding and steep waves • Partly one-person activities (increases vulnerability if something happens) • Development of damage and flooding is fast • Lack of training

Offshore	<ul style="list-style-type: none"> • Many new kinds of activities, limited experience and knowledge • High pace of development work and construction • Continuous development of technology and ways of operation • Large concentrations of energy resulting in high fire and explosion risk • High utilization of the space on platforms
Drilling	<ul style="list-style-type: none"> • Increasing water depth (high pressures, difficult to control) • Lack of knowledge about physiological factors • Ocean environment – splash zone risks • New work processes

In addition, Drugs and Alcohol are considered to be causes of accidents in maritime transportation among others.

There are also several maritime accident types and consequences as shown in the figure 12.

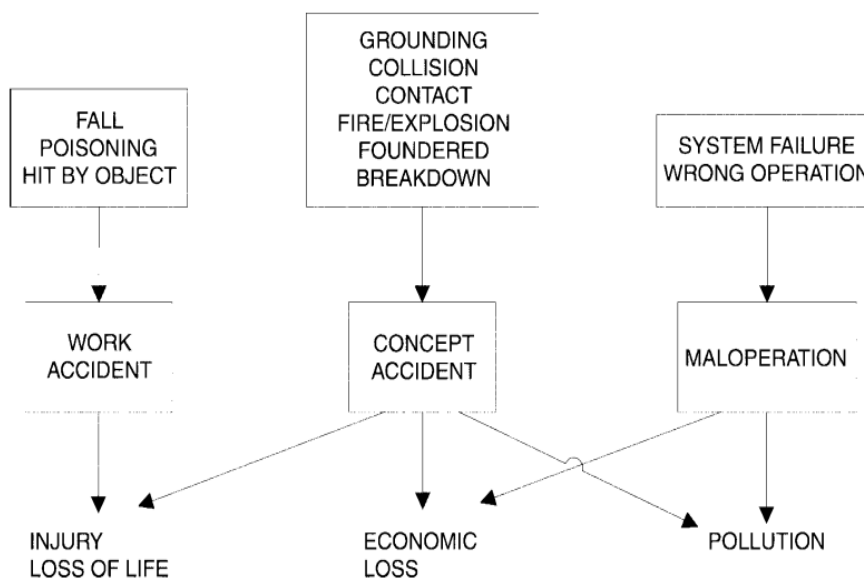


Figure 11: Maritime accident types and consequences [9]

Types of ships accident in maritime transportation

Cruise ship accident.

Fishing ship accident.

Tugboat accident.

Crude Oil Tankers and Cargo Ships.

III.2. Consequences of Maritimes Disasters

Consequences of Maritimes disasters are multiple. They mainly affect the following:

- **Safety of people and goods:** boat navigators represent the more exposed population to the risk of accident on work across the globe.
- **The environment:** accidental pollutions and illicit rejections of hydrocarbon are the cause of the ecosystem perturbations.
- **The Health:** the maritime transportation is a transmission channel of microbes and other contagious diseases. In the past, it was at the origin of serious epidemics, source of the practice of lockdowns for the ships.
- **The Economy:** A shipwreck full of cargo is loss of values. In specific case of hydrocarbon transportation, the sinister produce the chain of economic consequences such as devaluation of coasts, rise of costs for beach cleaning, the deficit of the image for the touristic sites and other related exploitation losses, contamination of fishing products, technical unemployment for fishing flotilla and other employments induced to the land. [21]

Table 2: Accident Phenomena

Type	Comment
Collision	Striking between ships
Contact/impact	Striking between ship and other surface objects
Grounding and stranding	Hitting the seabed or shore
Foundering and flooding	Opening and flooding of hull
Hull and machinery failure	Hull and machinery failure is directly responsible for the accident
Fire and explosion	Fire, explosion or dangerous goods release
Missing vessel	
Other Miscellaneous	

A variety of factors including the environmental conditions that maritime operations are exposed to and how work processes are coordinated determines the level of risk in the maritime sector [9]-Page29

The basic prerequisite for an accident to occur is that the vessel is in some state of activity, setting it at risk of one or more hazards.

The causal effect is the aspect of the process that presents the greatest challenge in terms of perceiving the accident.

Occurrence of an accident gives an acceleration feature within the system under consideration (e.g., a ship or part of a ship) is 'vaporized,' resulting in

physical harm and energy release, exposing individuals, the activity, and the environment to a variety of effects. It is important to apply experiences and evaluations to some kind of model to have a better understanding of the accident phenomenon.

The terminologies needed to explain the whole accident as a mechanism are shown in fig. 3.2.



Figure 12: The accident as a series of events.

The so-called occasional network, which leads to an accident, is made up of an activating incident and factors that contribute; such as organizational, environmental, and technical factors. The combination of multiple scientific disciplines such as engineering, psychology, and sociology, and mainly related to insufficient evaluation methods and a lack of standardized data, are partly related to an inadequate knowledge of the accident process and what causes this to happen should be identified.

There are several theories (with varying degrees of insight) as to why maritime accidents occur. Some main ideas behind are as follows:

- Negligence
- Pilot influenced of alcohol
- Variations from the norm accidental
- 'Operate of God'
- Cowboy attitude
- New phenomenon
- Improvisation
- Dangerous activity
- Lack of training

The factors presented above may be partly present in some accidents, but this is of little value if the accidental mechanisms are not described in terms of causes that can be influenced, such as system design, equipment failure, planning, operational procedure and organizational management.

III.3. Maritime transportation accident in DRC

The Public authority of DRC knows about the advantage of improving safety in maritime transport management by offering different types of assistance to the poor as during their activities well. Development of the wealthy agricultural and fishery resources of the country needs to be done in a safely way for everyone and the environment must be taken well care of. Maritime transport is seen as a fundamental constituent of the public road network through the arrangement of "road bridges" between singular ways of transport severed by water.

Rural water transport, figure 3.3 in form of boats is the alternative transport mode that provides low-cost access to the small islands and remote shorelines in DRC and connects villages along the banks of navigable rivers.



Figure 13: water transport in Congo river [22]

Likewise, government ships (ONATRACO) that would effortlessly go to join individuals, are many times broken down because of the aging fleet.

Researchers have gathered details from accident reports in DRC and has found out that maritime accidents in DRC have been huge, victims are many and damages have had to be borne. [23]

In 2008-2018 there have been serious accidents in the Congolese waters and day after day the number of accidents is increasing in DRC, where in 2018 (Table 3) there were about 6 accidents on the Congo River just in that river

without mentioning other operation areas in the waters of DRC. Observers' crew says that there are daily accidents in Congolese waters but most accidents are unannounced. [23]

Observers have also said that there are accidents every day in Congolese waters, but most of them are unaware because of the low-level of communication in the maritime sector of DRC. And some time, one can find out that an accident has happened when bodies or properties are floating in the water.

They also point out a variety of factors that mainly cause ships accident in Congolese maritime operations like the old boats without maintenance, overloading, lack of navigation skills of crews, among others. In addition, the presence of some vessels that are not known to navigate in the waters of DRC or are not often registered, which also makes authorities less aware of accidents or problems in the waters caused by those vessels.

On one hand, this researcher has also noted that poor ship and barge construction, missing life jackets for passengers and lack of rescue boats cause accidents too. On another hand, regarding people living near the Congo river, 90% of maritime accidents are mainly caused by over-packing, as well as the inability of passengers to swim.



Figure 14: passenger without life jacket during the voyage in DRC [24]

III. 4. Human Factor

Besides the factors discussed above, the concept of human error that may directly translated to operator error is often cited as the cause and explanation of accidents. Being at the so-called 'sharp end' of the system, the blame of the accident is often shifted to the pilot or operator of the system. [25]

The people at the 'sharp end' often deal directly with the dangerous situations as a part of their role, for example, the captain of the vessel. It is

at the "sharp end" that all real problems with the system are revealed, while also being the place where initiation of the hazardous events and accidents takes place mostly. On the other hand, the 'blunt-end' people like managers, designers, regulators and system architects, do not directly interact with the process or system operations but they have a greater responsibility for the situations that are faced by 'sharp-end' people because the distribution of the resources and their limitations is the responsibility of 'blunt-end' people. [25]

Although simple, the concept of human error for accident explanation has even reached some level of popularity among conservative engineers. From an engineering perspective, the concept of human error can be used as excuse to steer clear from the responsibility when the problems are not seen as technical issues. Engineers often seem to have a very positive or even narrow view of the cause of an accident and only focus on problems that can be solved by technical methods. [25] It is often easy to list the factors that may explain the importance of the presence of human errors in the accident without having to explain the cause of the accident. For example:

- Magnitude of operator-dependent systems
- Humans have restricted capabilities
- Lack of oversight in complex systems
- Inadequate design
- Lack of risk insight

During the direct interaction of technical systems with humans, the presence of active human errors is generally seen as the major cause of accidents. A survey of accident investigations reveals that around 60% of the accidents are the resultant of human errors. Furthermore, there are additional accidents that are indirectly caused by human errors related to so-called organizational factors (e.g., company policies, attitude towards safety, etc.). Generally, it is easier to consider human and organizational factors while performing qualitative risk analysis than quantitative risk analysis. [25]

Table 3: shows the status of maritime accidents on the Congo River registered during the year 2018 [23]

Date	Ship	Country	Location	Victims (dead and missing)	Passengers on board (estimate)
28 th February		DRC	Fleuve Congo, Kwamouth	115	260
The convoy of three boats capsized. Officially, 260 passengers were registered on the manifesto. There would have been in fact 500.					
24 th April		DRC	Oubangui river, a tributary of the Congo River	47	-
Three-quarters of the inhabitants of Dongo (DRC) fled the fighting between the army and the Enyele militia. The boat was overloaded and capsized while crossing the Oubangui river which marks the border between the DRC and Congo.					
25 th May		DRC	Momboyo river, tributary of Congo river, Tshuapa	50	110
The ship was carrying passengers and a large number of goods, and it sank for some reason. According to local authorities, she was sailing at night and without traffic lights. The exact toll is not known.					
18 th July		DRC	Fleuve Congo, province de Tshopo	26	100
The overloaded boat sailed at night, without lights; it hits a rock and sank.					
19 th September	HB Espoir	DRC	Mongala river, tributary of the Congo river	27	60
The death toll of 27 does not take into account the missing.					
11 th Octobre		DRC	Oubangui river, a tributary of the Congo	15	-
The boat struck a rock and sank on the Oubangui River in north eastern DRC. The number of fatalities varies according to the sources from 15 to 42 victims.					

It looks like that the mentioned mistakes are made by the stakeholders who think more about profit without thinking about the life of Human beings. The crews and operators play a main role in the causes of accidents in DRC's maritime transportation, but in order to find out the actual causes of the marine transportation accident in DRC

IV: Resultats Of Research

During this research will use both qualitative and quantitative method to analyse the collected data.

IV. 1. Qualitative research method

Within this qualitative method is able to find all relevant existing knowledge about this research by planning a research study in order to have a literature review, where it need to get information in search and find techniques and methods of appraisal such and the researcher will collected the necessary data by using both primary data and secondary data sources which are the following methods:

- Libraries
- Texts or documents analysis (such books, articles, reports, newsletters, etc...)
- Information services
- People
- The internet
- Evaluating web. Sources
- Doing literature review
- From existing data
- By helping of google Scholar, searching information about welding technology in maritime
- Phone Interview
- Field notes
- Questionnaires
- Film
- Observation

After collecting data, it needs to be analyzed by using the following steps:

Getting familiar with the data



- Revisiting research objectives
- Developing a framework
- Identifying patterns and connections
- Editing
- Coding
- Classification

Figure 15: Researcher analyse the data collection [26]

The primary focus of this research is the maritime transportation as this is the main means of transportation in the Congo River and the Lake Kivu. These are of importance as they connect many smaller cities and villages of the DRC which in turn connects the DRC to other neighbouring countries in the area.

For the research purposes of this research employees of the Department of Maritime Transport and Communications, crew members and passengers were interviewed over the telephone. As a part of the research a questionnaire was developed and sent to the respondents at the Ministry of Transport and Communication, captains on the Congo River and Lake Kivu. In addition, business communities around the coast of Congo River and Lake Kivu, and the maritime police of the area were also sent the questionnaire.

The policies and procedures followed at the Management of Maritime transportation in DRC were questioned and it was found out that they are for most part unclear, confusing, unsystematic, and very basic, while also being based on personal preferences of the owners of the ships. The structure and the type of management are also primarily determined by the owners of the ships and vessels.

The three types of vessel categories that exist in the waterways of Congo DRC are:

- the vessels owned by the authority
- private vessels and
- several small-time boat owners

Most of the population in the DRC region rely on maritime transportation using above mentioned different types of vessels as there lacks other means of transportation. In addition, most of the people of the region do not even know swimming and are still forced to use waterways because:

- there is major lack of road connectivity within the country,
- some parts of the country perhaps have roads, however, most of them are unusable and damaged to such an extent that their usage may be worse than using the waterways,
- use of airplanes is unaffordable due to poverty.

The owners of the vessels and small boats lack the basic education related to maritime transportation and navigation. They, instead, rely on traditional navigation methods, the knowledge of which is being passed on from one generation to the next. This lacks the introduction of modern developments of the maritime transportation.

The vessels owned by the large marine companies are mainly used for cargo transportation. These large companies usually do not follow all the required management methods; however, they are not fully aware of those methods.

A participant from the Ministry of Transport and Communication in the maritime department informed that he does not agree with the existing requirements in addition to criticizing the maritime Transport legislation of Congo DRC. This participant pointed out that the legislation lacks the management of maritime safety culture which has resulted in many maritime transportation accidents. The example of this can be observed from the image below which shows an overloaded boat. This type of overloading is observed on all types of ships.



Figure 16: overloaded boat [27]

In addition, it can be observed that most of the vessels, which are operated by unqualified crew, have aged and are being used without proper maintenance and technological upgradation.



Figure 17:Passanger in Congo River [28]

An example of poor maintenance practices can be observed from the example shown in the bellow image



Figure 18:Engine for barge from Kinshasa to Kisangani [27]

A part of the vessel’s engine broke down of this vessel that was travelling from Kinshasa to Kisangani. The broken part was carried back to the point of origin 45 mile away using a motorized pirogue for repair. However, the same part broke again, leading to repair work which meant another trip 45 mile back. Only after three days of efforts the vessel was able to continue its journey.



Figure 19: engine broke down [27]

The lack of life jackets can be observed from the picture below:

Passengers can be observed crowding the decks and roofs of the vessels on the Congo River.

The navigational charts are old and outdated and there is acute shortage of navigational aids among several other issues.



Figure 20: the Old map dating from the Belgian Colonial-era is still the only map use by boats travelling on the Congo River [27]

Picture: The old map dating from the Belgian colonial-era is still the only

In recent time the history of the Congo River has observed some of its worst disasters. For example, on 15th February 2021, a boat carrying 700 passengers capsized near the Longola village of the Mai-Ndombe province. It was reported that over 60 passengers lost their lives while over 200 were reported missing. It was later

reported that only 300 of the total 700 passengers survived the mishap. The accident investigation revealed that the boat carried too many passengers and their belongings added to the overweight. In addition, the poor light conditions due to night travel was also observed to be a contributing factor. [29]

There are requirements to be followed to carry out specific tasks in the basin community of the River Congo. These are also relevant to other aspects of partner states when it comes to standards, development, and regulations of maritime safety and reliability.

The requirements related to the maritime transportation in the Congo DRC were reviewed by the researcher. It was found that the country is waiting to respect conventions and to ratify the rules of CICOS and CEMAC to be able to reach the required safety on inland waterways and to minimize the incidents. That why the requirements need to be applied to all vessels whether new or old ones, with qualifications of the provisions as regards. [30]

When it comes to the already existing vessels; a clarification is required if and when these provisions shall apply to the existing vessels and when they are exempted. When it comes to passenger and cargo vessels, the

requirements set general standards without giving specific requirements for the two types. This leads to ambiguity and uncertainty during inspections and audits. The inspector or the surveyor then are unclear, during inspections and surveys, about what they should be looking for in two types of vessels. This challenge can be overcome by specifying requirements and standards for each type of vessel used for the Congo maritime transportation.

Vessels like passenger carriers and/or tankers, due to additional risks associated with, a) passenger carrying and b) carriage of toxic and other dangerous load like oil and gas, need special requirements other than general requirements applicable to them.

The requirements related to the maritime communication systems are also not clear and ambiguous, in that, there is no clarity as to who should be operating the communication equipment and how. There also is a knowledge gap in the requirements applicable to navigational aids and their installations. In addition, there can also be observed a void in the enforcement and implementation of the requirements related to maritime jurisdiction. Finally, although there are requirements that establish the seaworthiness of the vessels by means of inspections and surveys, their efficiency is not guaranteed. So, the effectiveness of these inspections and surveys is always questionable and so is the safety.

When it comes to the importance of controlling the maritime transportation with a legal system in the DRC, the researcher found out during the participant interviews, that there is a requirement and need of a legal regime to control its operations and business transactions. In the lack of such a regime, the private business owners will always try to maximise their profits. It is crucial that there are provisions of legal systems for the maritime transportation sector that will ensure that the power of the private vessels owners is reduced to the minimum needed. Requirements established by such a legal system will ensure a collective good for the whole country or society as opposed to individual gains. The road and traffic safety rules are a good example of such a legal regime which sets requirements for all the citizens as they must be licensed to drive. This ensures that all the drivers are qualified to drive and road safety is ensured to a great extent. On the same principle, there should be legislation for all vessel operators to have relevant licenses required for vessel operations.

(The basis for the STCW Convention). The participants from the Ministry of Transport and Communication on questioning about the issues of legal systems responded by saying that the existing rules are good enough however, they must be updated to meet current trends of the sector.

When the participants were questioned about the causes of the marine accidents in the Congo DRC, the Ministry of Transport and Communication officials associated the accidents with outdated sailing practices. For

example, by beginning the voyage without precise weather reports, overloading the vessels, badly constructed and badly managed vessels, as well as poor training of Crews or unqualified vessel entrepreneurs and technicians. In addition, poor fire safety practices lead to major marine accidents. It was discovered that small vessels and barges are involved in almost all maritime accidents in the Democratic Republic of Congo.

The researcher observed from videos available on Internet that since the small vessels and barges are riskiest and kill a lot of people every year the possible safety strategies must be targeted to them. Setting standards for boat building, establishing a policy that incorporates these standards, and finally passing legislation that enforces the standards, among other requirements, could be the starting point for the safety strategies.

Vehicles are manufactured according to the standards and regulations of the country of origin, following international standards for manufacturing. Similarly, the marine vessels in DRC should be constructed and maintained according to the standards and regulations of DRC and also follow the international Standard for Ship design and Construction as IMO recommends. These standards and regulations must be protected by the DRC's legal framework.

The legal framework can also be used to ensure that vessel owners keep their vessels in good working order by inspections on a regular basis.

The issue of over-loading should be addressed in the framework, so should the manning of the vessels that will ensure sufficient numbers and quality of the operators needed for each vessel.

On the issue of how the government assists maritime transportation in DRC through the Ministry of Transport and Communication, the researcher found out that the government has a special department in the Ministry called "Direction de la marine". They government uses this department to improve inland water transport which also conducts operations related to inspections and licensing of the vessels. Training exercises are also the responsibility of the Direction de la marine. The participants expressed the need that the government should give similar level of priority as it gives to other transport modes. The majority of participants disagreed strongly with the notion that the authority aids the maritime transport sector.

The researcher reviewed the literature from the internet and videos observed, and found clear documentation that water transport in Congo DRC is certainly dangerous and it is the cause of many accidents due to negligence and disregard for the requirements, which are applied to crews and passengers related to safety in water during water traveling. Insufficient life jackets, poor visibility, and dangerous waters, as well as passenger and ship's captain attitudes, combined with careless operations, all contribute to disasters in Congo DRC's water transport.

Linked to the same literature that was reviewed by the researcher, a survey carried out by a DRC radio network, Okapi Radio, found that almost 80% of the many fishing boats along the fishing islands operate with barely any safety. In April 2019, 17 people died and several other went missing after the boat carrying them capsized. Over 150 people died early this month when an overloaded boat was overturned during a stormy weather in Lake Kivu in Congo DRC. Since 2008, similar accidents as mentioned above have resulted in 6000 people dead throughout the Congo maritime industry and these accidents are often attributed to overloaded boats. [27]

The Congo's rivers and lakes become dangerous due to prevailing winds caused by the hot seasons. However, the real issue is that humans, in their pathetic attempt to make a profit, ignore their liability to safety and scarily overload their vessels. Despite the fact that the government is needed to take action to improve people's safety, this is routinely dismissed and therefore, the passengers are seriously at risk.

The researcher found out through the telephone interview that from the marine department at the Kisangani port, no one inspects the vessels or ensure that they are not overloaded. However, even if someone was present, they mostly worked as per vessel owner wishes. Previously, a certain inspector who needed to provide passenger services had to obtain permission from the Ministry of Transport and Communication's Department of Maritime Transport, "Direction de la Marine".

There is a provision of beach management units which are required to monitor the activities in the water ways. However, they lack the skills to evaluate whether or not the vessel is overload and which kind of goods carried is good or dangerous.

As a consequence, vessel pilots are relatively free to do anything they want, and safety is certainly not one of their primary goals.

Even though the Captains are aware that they should have two engines, few of them follow this rule and sail with only one engine, insufficient fuel, and, in many cases, no life jackets. Vessels are very often seen to be overloaded.

Indeed, Captain Dominique Esele, who transports people and goods between Kisangani and Kinshasa, claims that captains collaborate in circumstances that increase the probability of overloading. They reach an agreement and make a decision to transport passengers both ways. The purpose is to reduce price war; however, the result is that there are fewer ships accessible to transport passengers. The insufficient number of life jackets on ships exacerbates the situation.

Further analysis of the accidents in DRC waters made clear that the travellers might have survived the tragedy if it had been obligatory for them to wear life jackets while crossing the dangerous waters. However, there seems to be lack of such a regulation that mandates wearing of life jackets.

Some passengers wore life jackets during the voyage, but the majority of them provided little or no protection during the accident because the jackets had loose strings to fasten them. Furthermore, because many of the jackets are old, they are not strong enough and would be taken away by heavy winds easily. These unsuitable-for-purpose jackets are inexpensive, costing only 31,500 FRC. Genuine jackets, on the other hand, can cost up to 71,500 FRC and include reflectors, whistles, and good straps. Fortunately, many passengers remove their jackets and use them as pillows instead, further hindering their already precarious safety. Even if a person has never attended a marine education, he or she can use common sense to evaluate whether or not a boat is overloaded.

The harbourmaster may issue orders for individuals to disembark from the overcrowded boat or even seize the boat's engine. Normally, each boat at the landing location is painted a distinct colour, however the colours are used to signify ownership rather than to determine maximum load onboard. Because so many boats depart and the landing place being overcrowded, the journey might be dangerous as too many boards each vessel.

It must also be noted that because there are no navigational landmarks to show routes, captains must rely on their abilities to know the details of the route and in particular the locations of sandbanks. [31]

On the problem of relevant regulations of hazardous materials transportation by water, data from the internet show that the transportation of hazardous materials is governed and controlled by a range of relevant frameworks operating at both the national and international levels. [32]

Among the UN Suggestions on the Transport of Dangerous Goods, refer to the ICAO Technical Guidelines, the IATA Dangerous Goods Regulations, and the IMO's International Maritime Dangerous Goods Code. The requirements for ability to handle, packaging, marking, and transportation of dangerous goods are set by these regulatory documents jointly.

In this context, "dangerous products" refer to products or things with hazardous properties that, if not carefully managed, pose a risk to human health and safety, infrastructure, and/or modes of transportation.

Regarding the Regulatory Framework and Transport Policy, ONATRA and the Marine Directorate and Navigable Ways are in charge of inland waterway maritime regulation in the DRC.

The CEMAC Agreement on Inland Waterways Transport represents an agreement between Cameroun, the Republic of Central Africa, the Republic of Congo, Gabon, the Equatorial Guinea, and Tchad that guarantees the safety of navigation and the mitigation of inland water pollution while taking into account the principles outlined in the appropriate Maritime Convention.

In order to build and sustain a rational, coordinated, and mutually advantageous inland waterway transportation system, the countries must be committed to harmonizing and simplifying the legislation, standards, and regulatory guidelines for interstate inland waterway transportation. The agreement establishes universal safety requirements for vessel inspections, safe and satisfactory crew, and the supply of navigational and radio communication equipment. As a result, the agreement adopts key concepts that allow for formal cooperation of registration surveys and safe staffing authorizations.

Furthermore, the agreement permits governments to implement the International Maritime Organization's (IMO) guidelines for collision prevention and to adopt standard regulations for implementing rescue efforts in the case of a marine mishap. The Agreement also implies a requirement to standardize mitigation of marine pollution laws. It also identifies several broad principles governing the carrier's obligation for merchandise loss or damage, as well as responsibility for physical harm and death resulting from passenger transportation. The CEMAC/DRC Legislative Assembly is also considering requirements for dealing with maritime transportation management in DRC. A suggestion has been made to establish a general safety framework that will successfully implement the convention in relation to river and lake navigation. For inland waterway transportation, the CEMAC has adopted the Agreement.

The CEMAC Convention/ Agreement also provides an appropriate framework for coordinating subsector legislation. However, the Agreement must be further interpreted within the national requirements of each state.

The CEMAC is also working on legislation to guarantee a coordinated response to the member countries' river and lake safety standards. The regulations could serve as a model for unified safety requirements across all CEMAC waterways.

A slow progress with ratification and the implementation of regional treaties and agreements is identified as one of the causes that drives the high costs of transport in the region. In addition, inadequate port management and insufficient ferries services organization have been cited as other sources of maritime transportation problems in the Congo DRC.

The framework outlines that the corporate maritime market operates and manages all services in the inland water sector. Assuming, of course, that the corporate maritime market is committed to certification requirements to assure acceptable quality and safety. The researcher's analysis of the Descriptive Experiment on the Northern and Northern-South Corridors,

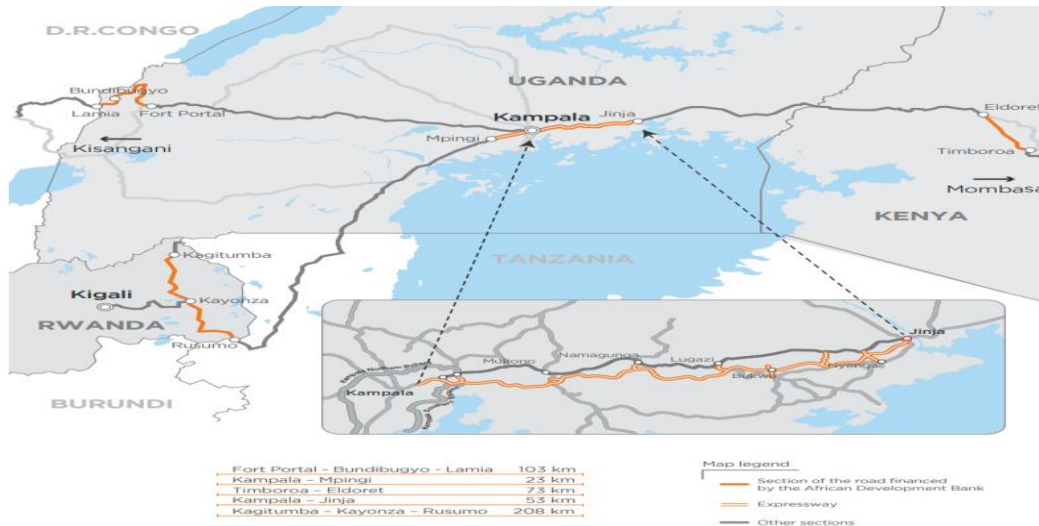


Figure 21: Northern Corridor Developing trade from between Kenya, D.R.Congo and Rwanda

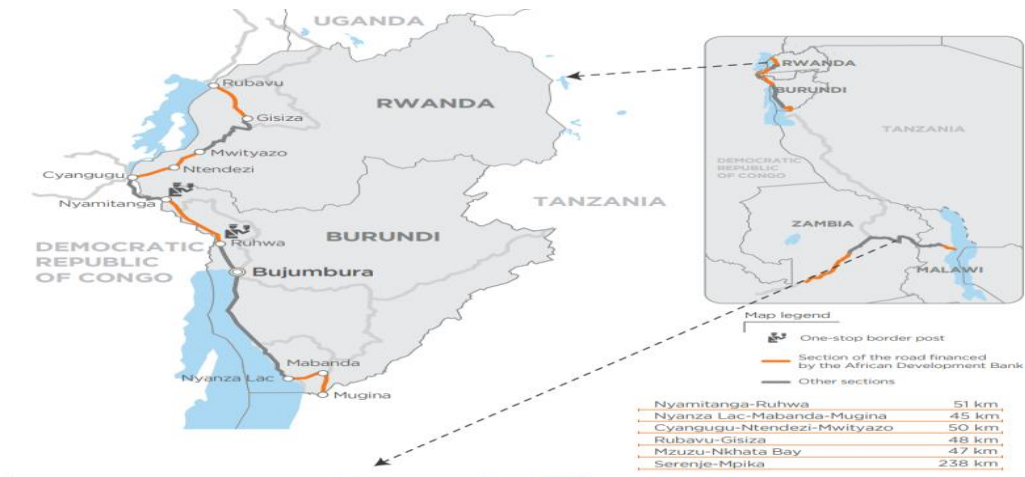


Figure 22: North-South Corridor (North section) Reinforcing connectivity in the Great Lakes region.

The improving the private sector's investment in port infrastructure and services is the main emphasis of the legal and regulatory efforts to establish a framework for improvements of shipping ports and inland water transport. [33]

DRC Overland Transport Map:

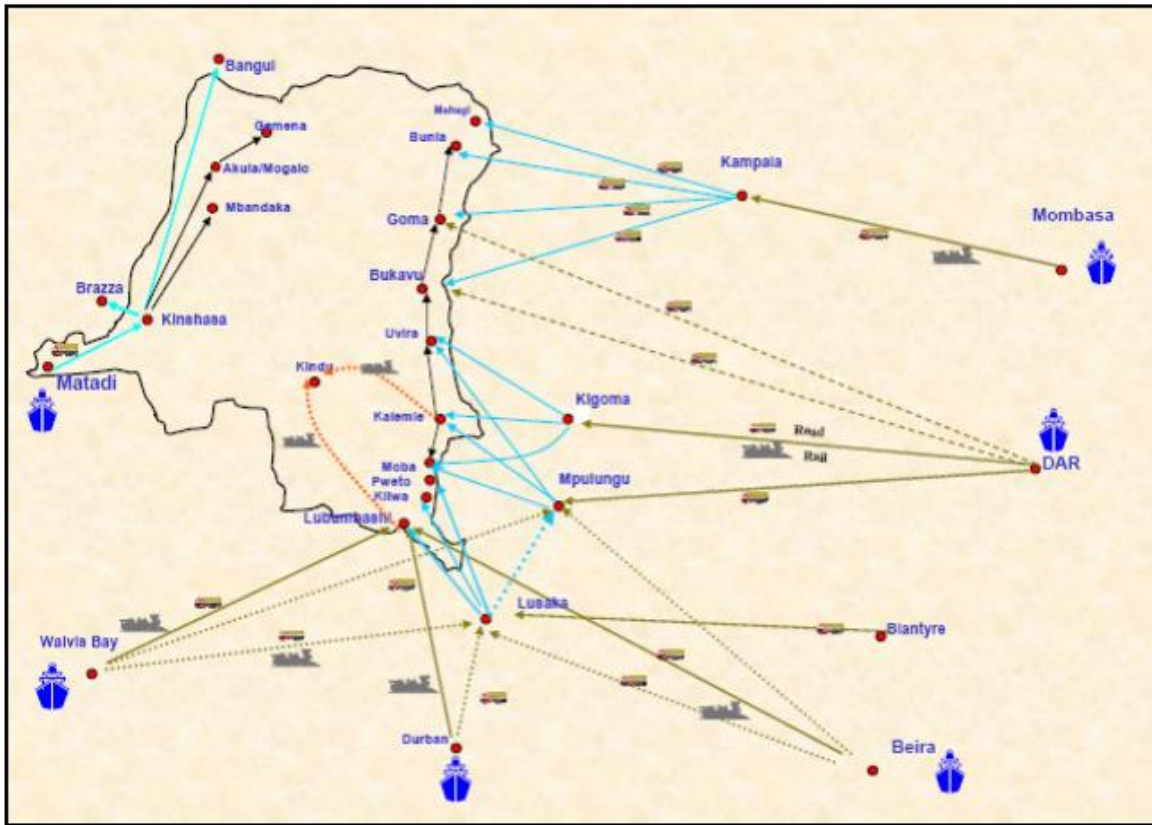


Figure 23: Maritime corridors for Congo DRC [34]

It is also worth noting that the Congo DRC's project planning and procurement structure is still in its development. Legal reforms are also required to provide enabling legislation to facilitate PPP agreements for inland ports and maritime services.

According to the text of the ordinance law no 66/96 of May 14, 1966, any boat must be registered and recognized suitable for navigation to be put into service. The researcher reviewed persons at the Inland Water Transport (Control) and Vessels (Registration) regarding these requirements and discovered that they were not adequately applied. It has been noted that the regulations surrounding maritime safety in DRC are quite vague.

There are no clear guidelines for who should operate such vessels. The need for such guidelines to address the problem of reducing marine accidents in the Congo DRC is noted. Special measures, such as the right of vessels to reach ports and refuge, as well as assurance on the performance of inspections and verifications, are also needed. This is critical because otherwise, particular marine problems that are not addressed by the legislations may not be subjected to state-wide general standards.

The researcher's analysis indicated that the lack of maritime industrial capacity and funding sources needed to conduct boat inspections and implement existing rules increased the problem of marine accidents.

Furthermore, the Congo DRC lacks the basic criteria for boat construction. According to Captain Gabriel, the challenges associated with water transportation can only be remedied if the Congo DRC gives enough education and training in boat building to its population, as well as having boat building standards in place.

Maritime transportation is one of the biggest issues faced by people living on coasts and along the shores of lakes and rivers. It should also be mentioned that users of local water transportation means are well concerned about the possible connection between transportation and development in their communities. They are conscious, too, of how poorly developed water transport systems relate to their loneliness and mistreatment. The researcher points out that the water transport system in the Congo DRC needs a well-developed infrastructure that would ensure improved service similar to that of formal water transport vessels, resulting in reduced marine accidents.

According to interviews with some of the trade associations in the neighbourhood of the port-Kisangani and Kinshasa landing sites, the facilities are now in bad shape and they require immediate renovation.

One of the key concerns raised was the problem of safety, which affects both customers and employees at the sites.

The fishing community (Figures 25 and 26) was particularly concerned about bad weather and ineffective life jackets in high winds. Participants of these sites expressed their distrust in the government, claiming that authorities from the Ministry of Transportation had been of no practical support to them.



Figure 24: Fishermen in rough water fo Congo River [35]



Fishermen gather vegetation to place in their fish nursery.

Figure 25: Fishermen in congo DRC water

The researcher observed that the present state of institutional framework within the ONATRA is inefficient in handling the issues related to water transport services, particularly in the rural areas.

In an expert YouTube video report, the captain of a vessel on Congo River pointed out that the lack of navigation charts and signs increased the chances of marine accidents, because today there is no Chart navigation map updated for this time. They are still using the ones Belgians they did prepare when they were colonizing the Congo DRC. [36]

Observance of safety measures in marine transportation should best be achieved by coordinated actions between partners in the public and maritime commercial sectors.

The marine management must also focus on safety standards in order to effectively deal with the consequences of marine incidents, which may include effective rescue performance and adequate hospital treatment for survivors.

The researcher discovered during the phone interviews that several of the ship captains now running marine passenger vessels were only trained to operate marine tankers. In the event of a maritime accident, some of them are unsure of how to assist ill-fated travellers.

The major causes of the sea tragedies, according to the Okapi Radio report are:

- Overloading the vessels
- Negligence on the part of management in allowing vessels to sail even though they were not designed for sea travel.
- Allowing people to swim in heavy waters during inclement weather.

To the obvious concerns are mentioned that negligence, lack of professionalism, a lack of responsibility, and corruption have been identified as barriers to the development of inland waterways in the Democratic Republic of the Congo (DRC).

There are not many large vessels, cargo boats, or oil tankers available for transport. However, for cargo transportation between the landing places, large, uncovered, wooden motorized boats (carrying between 3 and 12 tons) are mostly used. While boats are frequently used for navigation, they lack lifesaving equipment. This results in many lost lives due to drowning on the rivers and in the lakes. An estimated 6000 deaths per year.

Furthermore, accidents are caused also by the issues that many of investigation or observers in Congo maritime accident don't mention, like:

- Lack of visibility for the Captain, Figure 27
- Lack of sea marks
- No communication channels available
- Lack of rescue boats
- Limited lights available on the vessels
- Ship's construction and stability: understanding of ship construction according to welding of joint metal structure and testing.
- Lack of navigation systems, etc...

Captian of the ship



Figure 26: Figure showing a river boat [31]

The CEMAC agreement contains rules regarding navigable water resources in the area, the most significant of which is the Congo River Basin, which plays an important role in inland transportation while also offering opportunities for tourism development and water activities. As a result, it is critical that port performance, navigational safety, and marine safety are all improved.

Also note that coastal and inland watercourse transportation plays an important part in the delivery of material and passengers.

As a result, the Maritime and Ports sectors are confronted with substantial issues such as;

- Congestion
- Insufficient infrastructure development
- Aging ships maintenance equipment and,
- A lack of staff

However, these are just a few of the issues.

The researcher observed when reading the CEMAC community plan that the Maritime and Ports Authorities in the Partner States meet on a regular basis with help from the CEMAC Community Secretariat to assess and implement regional initiatives and programs in the sector. The joint committee has selected several areas to complement ongoing work at the national level.

Similarly, the researcher examined the CEMAC Community Development Policy and discovered that the strategy outlines the following objective and strategic intervention areas in the maritime transport and ports sectors:

IV.2. Quantitative research method

By using quantitative research method, the researcher needs the data providing details are need to provided good resultant. Researcher will collect quantitative data by using methods based on random sampling and structured data collection instruments which can easily compare, summarize and generalize statistically.

Both primary and secondary data collection methods will be used such as:

- **Phone interview**
- **Questionnaires**
- **Mathematical**
- **Observation**
- **Action research**

The researcher will access information from responses of questionnaires distributed to different participants. where different people related to maritime transportation in Congo DRC are answered. After step of collecting data; researcher will analyse what respondents have given as responses by using descriptive and inferential statistics data analysis.

The researcher will analyse data by measuring make comparisons, examine relationships make forecast, test hypotheses, explore, control, explain and construct concepts and theories from data collected. Adding coding to response choices on the questionnaires sheet will simply the transfer of data. Plus, to analyse data, table and charts will be used, also interpretation representing the application of deductive logic to research and data analysis from responses of questionnaires distributed to different participants.

All data with different sources will be analysed and interpreted, compare together in an organized manner in order to give full, clear and useful information to this research project.

Bellow there is table of Data collected from respondents.

IV.2.1. Questionnaire

A questionnaire was sent to a number of potential respondents all located in Congo DRC. 20 persons answered the questionnaire. Due to poor internet connections, fewer than expected did answer. Anyhow, the results are summarized below.

Questionary form

Table 4: Causes of maritime accidents

What are the causes of maritime accidents in Congo DRC?	Respondents	Percentage
--	--------------------	-------------------

Backward sailing practices	4	20
Boat over-loading	12	60
Poorly build boats	0,8	4
Poorly maintained boats	1,6	8
Trained or untrained builders and operators	1,6	8
Total	20	100

According to the above table 5 in, 60% of participants said that ship overloading was the main cause of Congo DRC maritime accidents, while 8% said that well-trained or untrained construction companies and owners were to blame for DRC's main cause of marine accidents.

This is also interpreted in the statistical diagram below.

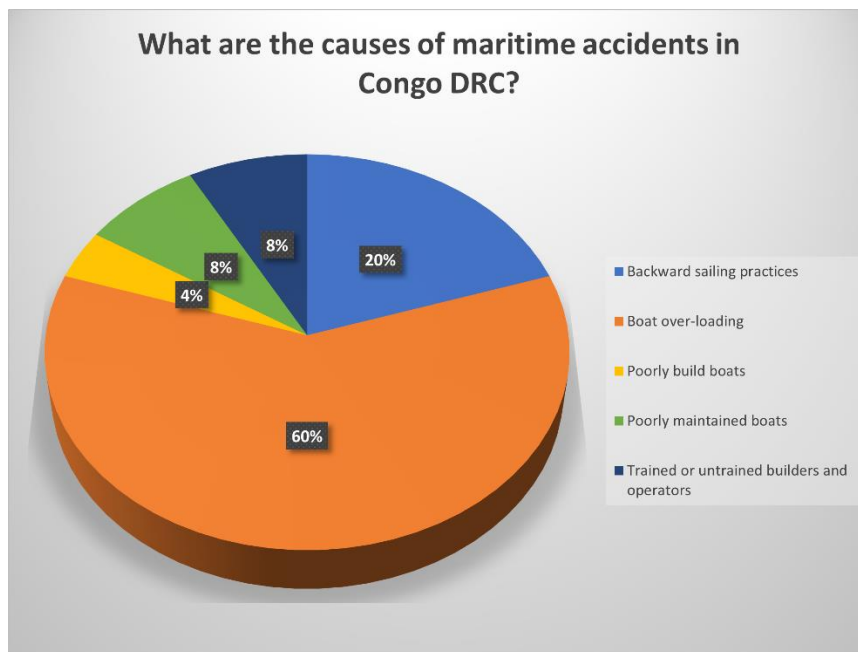


Figure 27: Causes of maritime accidents

Table 5: How is the management of maritime transportation in DRC?

Is maritime transportation managed properly in RDC?	Respondents	Percentage
Agree.	4	20
Disagree	8	40

Strongly Agree		4	20
Strongly Disagree		4	20
Not sure		0	0
Total		20	100

Table 6 above show that 40% of respondents do not agree that DRC's shipping management is good, while 20% strongly disagree. This shows that DRC shipping is poorly managed

Figure 23 shows statistic of the result of respondents

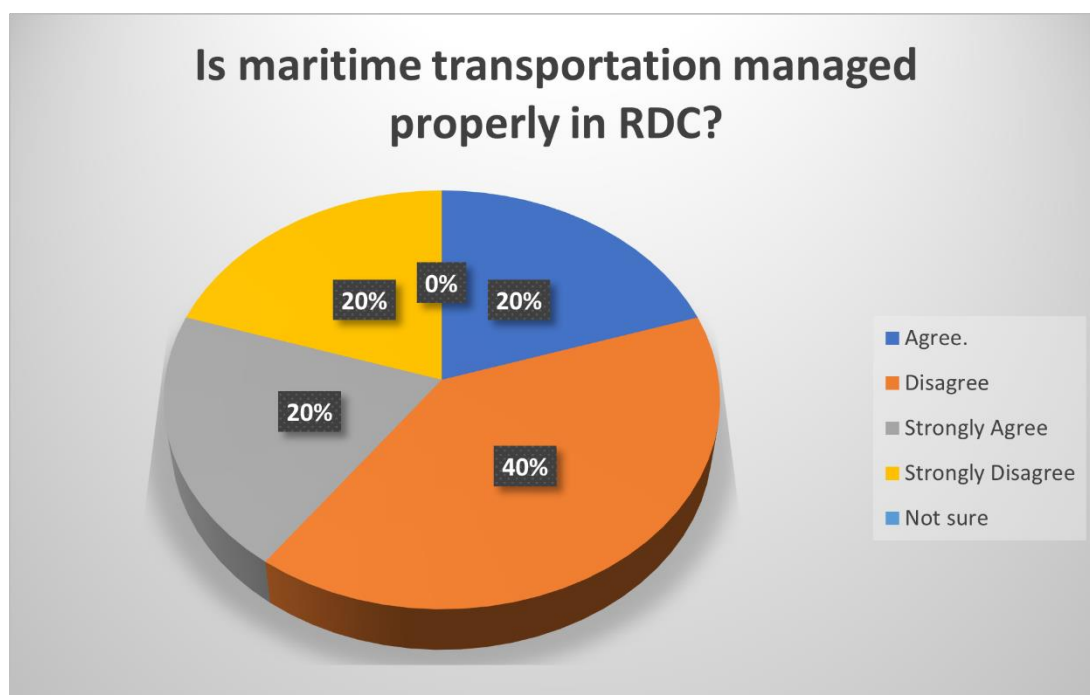


Figure 28: How is the management of maritime transportation in DRC

Table 6: Using of International Standards

Is it important to use International Standards for maritime transport in the DRC?	Respondents	Percentage
Agree.	3,2	16
Disagree	1,6	8
Strongly Agree	4	20
Strongly Disagree	6,4	32
Not sure	4,8	24
Total	20	100

As can be seen from Table 7 above, 20% of respondents fully agree that it is very important to use International maritime Standards maritime

transportation in the DRC, while 8% of respondents do not agree. 24% are not sure if it is important to use international requirements. 32% of those surveyed strongly disagree.

From this result, the researcher found that the reason that 32% so strongly disagree, is because the belief is that if the authorities and vessels owners could implement and respect the CICOS/CEMAC requirements, this could increase the safety in the maritime transportation in DRC because those requirements are referred to IMO requirements.

Figure below shows statistic of resultant analysis in %

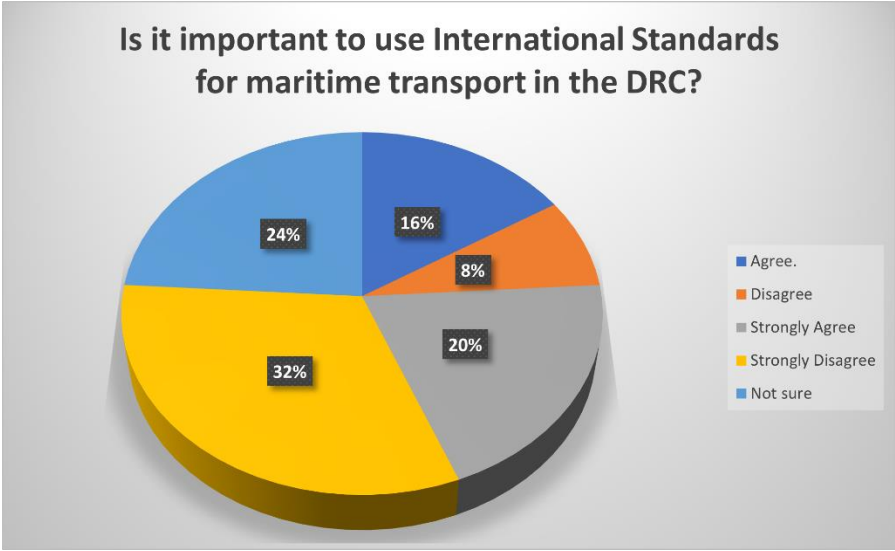


Figure 29: Using of International Standards

Table 7: The Authority assistance.

Is the authority's assistance to maritime transport through the Ministry of Transport and Communications sufficient?	Respondents	Percentage
Agree.	0	0
Disagree	4	20
Strongly Agree	2.4	12
Strongly Disagree	12	60
Not sure	1,6	8
Total	20	100

As said in the table 8, 60% of respondents strongly disagree that the government's financial support to maritime transport through the Ministry of Transportation and Communication is adequate, while 8% are unsure.

The information presented above can be further illustrated using a chart diagram, as shown in the figure below.

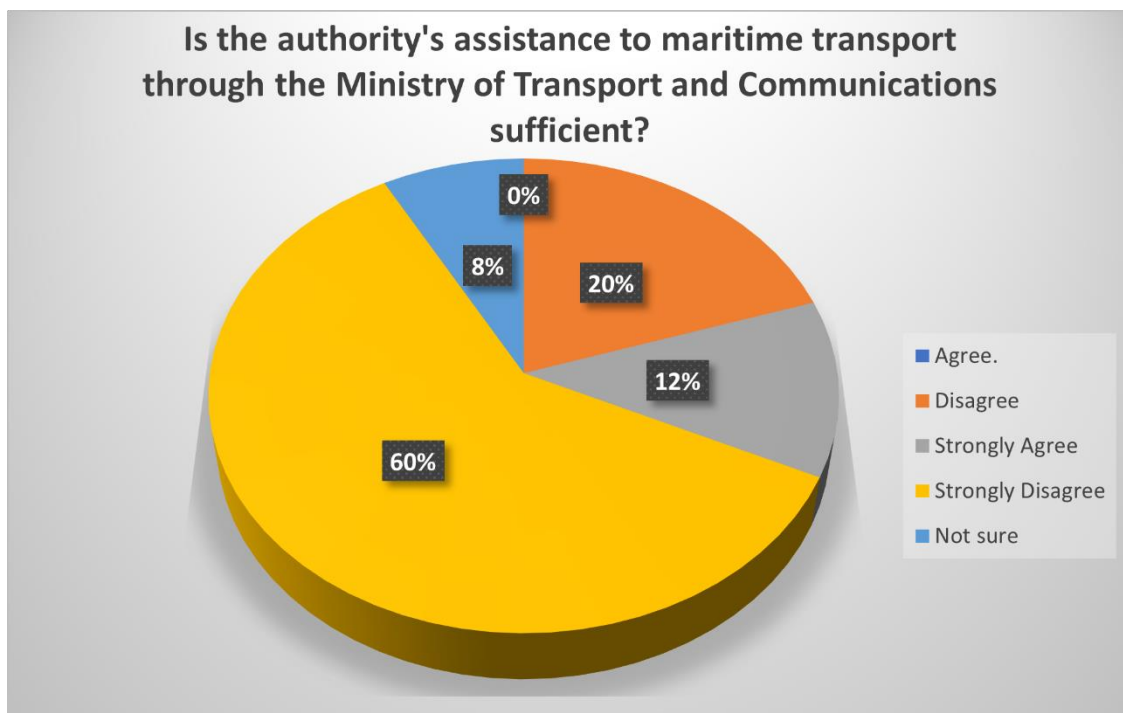


Figure 30: The Authority assistance.

Table 8: Challenges for control agencies.

What are the challenges that the DRC's maritime transport control agencies are facing?	Respondents	Percentage
Legal challenges	6,4	32
Environmental conditions	4,8	24
Safety challenges	3,2	16
Financial challenges	4	20
Others	1,6	8
Le total	20	100

As can be seen from the table 9, above, 32% of the respondents said that legal challenges are the biggest challenges facing the DRC's water transport monitoring agency, while 8% of the Respondents said that the DRC's water transportation monitoring agency also faces other challenges. Figure below shows the statistic of chart diagram of respondents

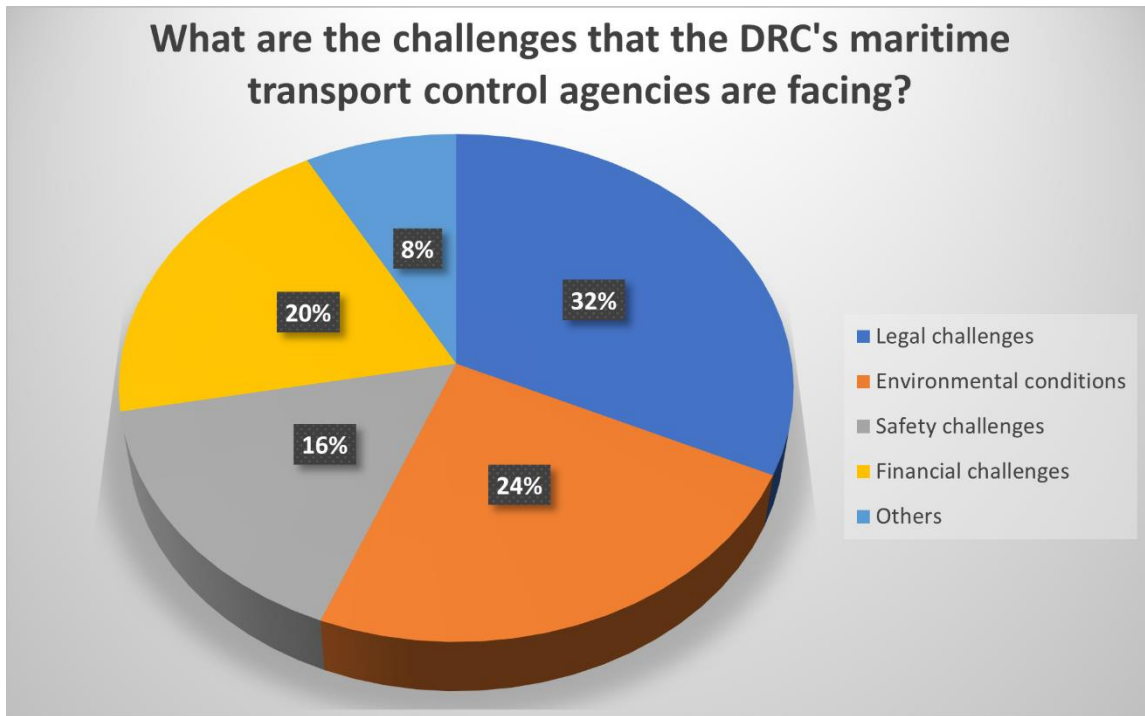


Figure 31: Challenges for control agencies.

Table 9: Kind of ships accident.

Which types are the most ships accident in maritime transportation in Congo?	Respondents	Percentage
Cruise Ships accident	4	20
Cargo ships accident	3,2	16
Fishing ships accident	10,4	52
Oil Tankers ships accident	2,4	12
Others	0	0
Total	20	100

From the table 10, above, 52% of the respondents said that fishing accidents causes the largest type of marine accidents, while 12% of the respondents said that tanker and cargo ship accidents are part of various maritime accidents in maritime operations in DRC.

Figure below shows the statistic of chart diagram of respondents

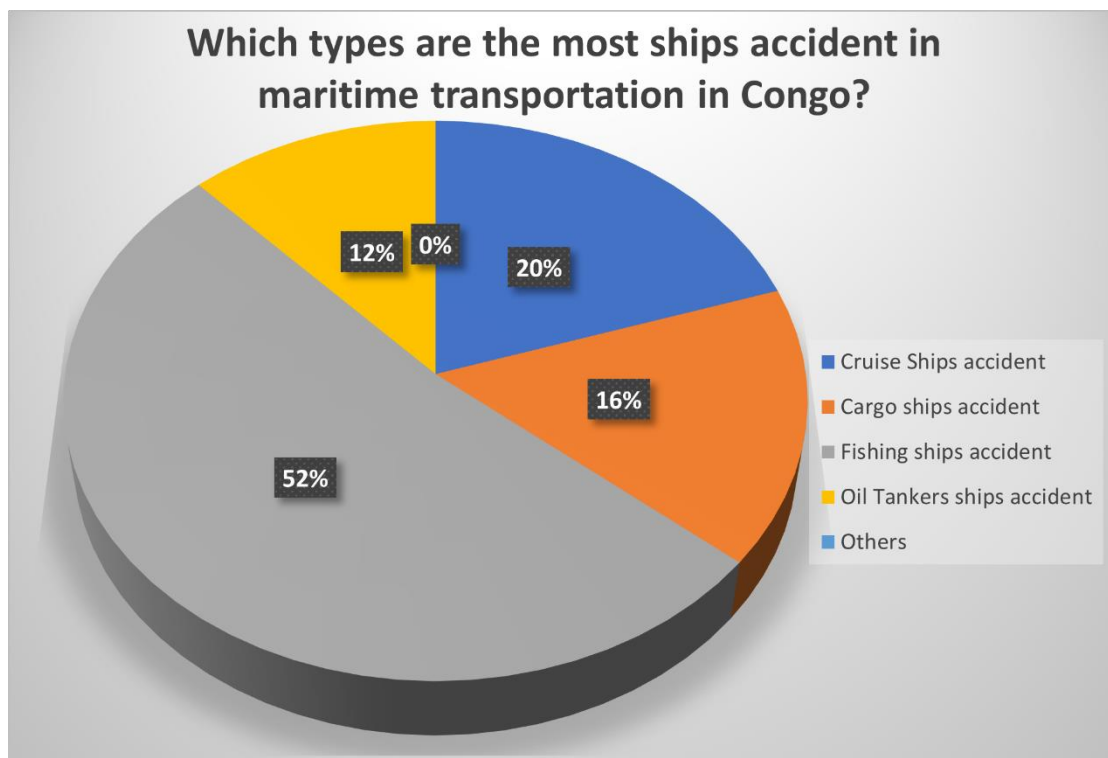


Figure 32: Kind of ships accident.

Table 10: Local residents challenges.

What are the challenges faced by local residents who use waterway transport in Congo DRC?	Respondents	Percentage
Insufficient financials	8	40
Expensive life Jackets	4,8	24
Institutional framework unknown	7,2	36
Other	-	
Total	20	100

According to the above table 11, 40% of respondents said that insufficient funds is one of the issues that locals face when using shipping, while 24% mentioned expensive life jackets.

36% of those surveyed did not know of the agency in charge of shipping.

Figure below shows the statistic of chart diagram of respondents

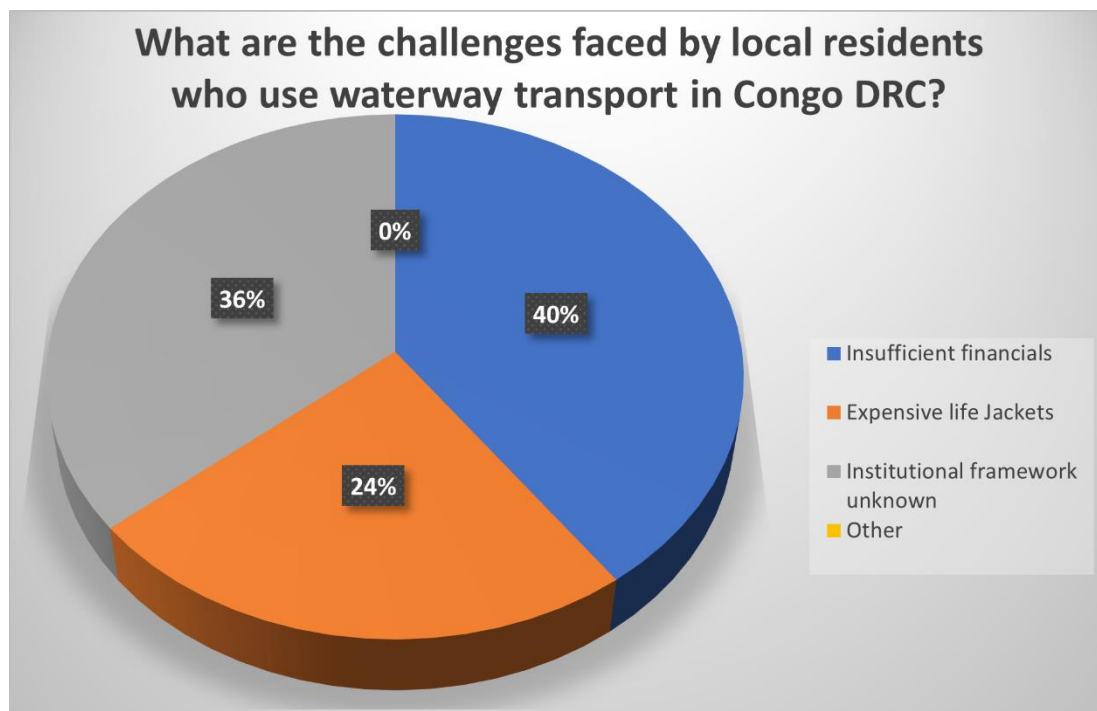


Figure 33: Local residents challenges

Table 11: Strategies of the ministry of transport and communication to reduce maritime accident in DRC.

What strategies has the Ministry of Transport and Communication put in place to fight against maritime accidents?	Respondents	Percentage
Recruitment of personnel with experience in inland waterway transport	12	60
Recruitment of personnel with experience in maritime transport	2,4	12
Plans around the landing sites regarding safety at the maritime transportation.	2	10
Monitor ship operators to meet minimum standards requirements.	2	10
Developing national water transport policy to improve maritime safety.	1,6	8
Total	20	100

Based on the data in the table 12, above, 60% of respondents said that recruiting personnel who are familiar with inland water transport is the most compelling strategy adopted by the DRC Ministry of Transport to reduce accidents. 8% of respondents said that the formulation of river transport policies to improve safety is the most convincing strategy adopted by the Ministry of transport and Communications to reduce maritime accidents in DRC. Pie chart show in % resultant from respondents

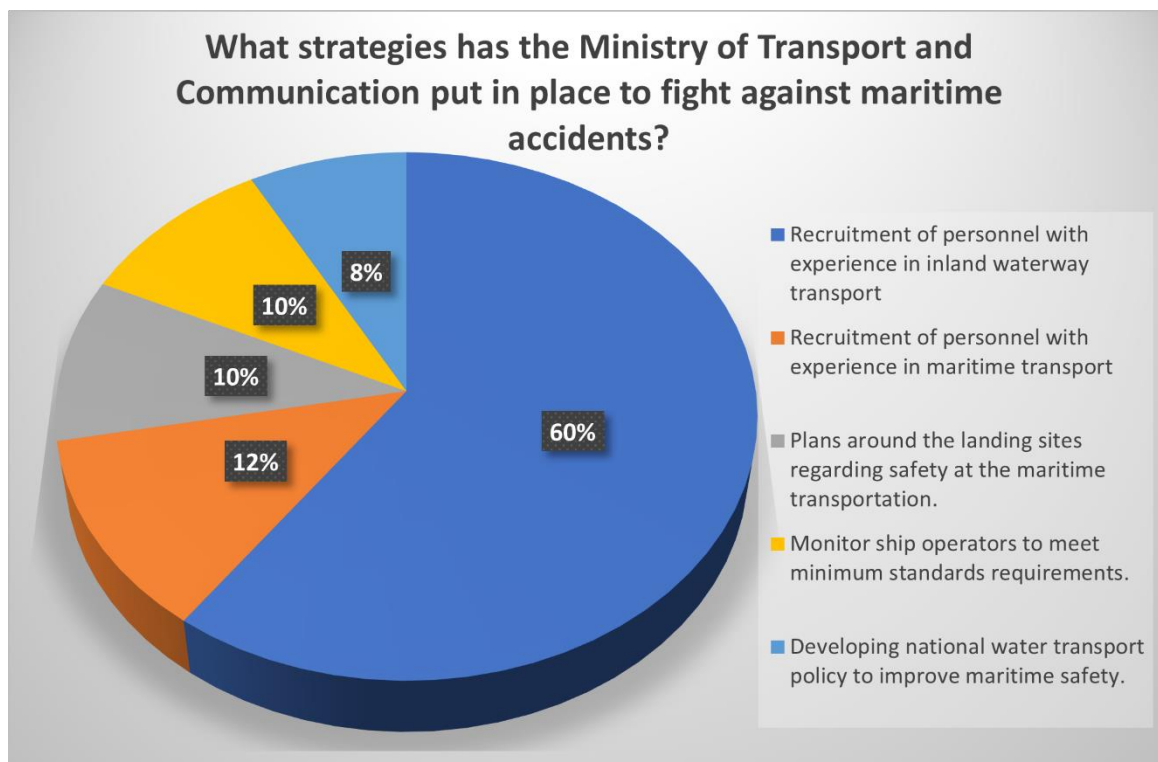


Figure 34: Strategies of the ministry of transport and communication to reduce maritime accident in DRC.

Table 12: Answer for maritime accidents in DRC.

What do you recommend as the solution for safety in maritime transportation in Congo RDC?	Respondents	Percentage
Improve construction capacity in the marine industry	3,2	16
Adopt a policy to integrate safety standards	4,8	24
Update existing ratification	8	40
Increased funding for authorities	3,2	16
Others	0,8	4
Total	20	100

According to the above table 13, 40 percent of respondents believe that updating existing regulations is the best solution for transportation, while 24 percent believe in safety standards. Increased government transportation funding was suggested by 16% of respondents.

This is also interpreted in the statistical pie-chart figure below.

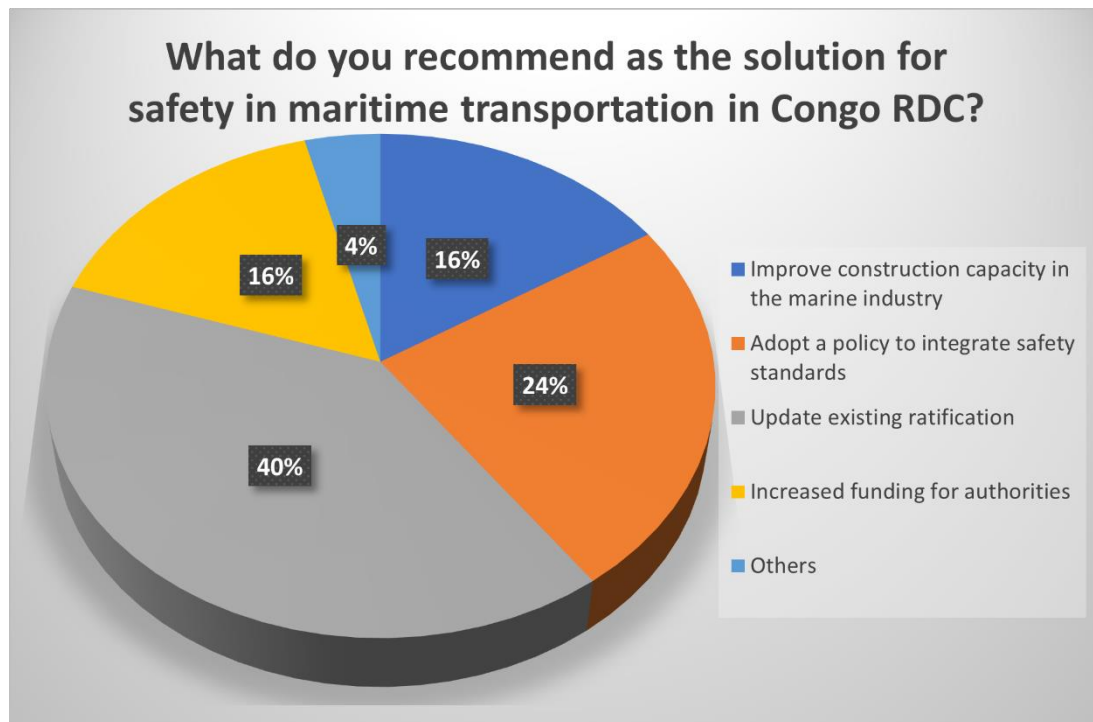


Figure 35: Answer for maritime accidents in DRC.

IV.3. Comments to the answers by the respondents.

The answers from the respondents in general supports the findings from the research it is shown that the management of maritime transport is disorganized, haphazard, rudimentary and is based on personal preferences of the owners. The vessel owners determine the forms of management themselves [37] .

The numbers of accidents have risen because of such attitude. Marine Transport Accidents have been categorised as:

- Cruise Vessel Mishaps,
- Commercial Fishing Mishaps,
- Accidents on Tugboats,
- Accidents on Crude Oil Tankers and Cargo Ships,
- Maritime accidents due to drugs and alcohol and
- Cargo hauling accidents.

The outdated and obsolete requirements are observed to be causes of marine accidents. As these do not provide for safety standards and regulations for vessel manning. Furthermore, overloading, incompetent and unqualified crew, use of old boats, out dated navigational charts and absence of navigation system, backward sailing practices and untrained boat builders, among others are of concern.

Further it has also been observed during the research that majority of the accidents in the Congo DRC involve small vessels. Therefore, it is crucial that the government prioritizes requirements relating to small vessels in terms of safety and boat building standards. In addition, policies to adopt these standards should be incorporated while passing the legislation for the enforcement of the established standards.

V. Discussion of how IMO should be introduced in Maritime transportation in Congo DRC

V.1. The IMO international maritime conventions ratification at DRC

The maritime sector recognizes a constant evolvement worldwide. Such evolvement goes together with different laws adapted to the current context of the maritime sector. This situation is in line with the international requirements in this sector. The maritime incidents have multiple causes which have been studied with the major purpose to amend the existing situation to prevent future incidents which may occur. Consequently, regular adoption of conventions governs the safety at sea; pollution preventive measure and trainings are made by the International Maritime Organization (IMO). In addition, through its exiting conventions, the International Labour Organization (ILO) regulates also the working conditions on ships. The UN together with different specialized units or bodies put in place other rules governing transport of goods by sea. These include the Hague Rules of 1924, The Hague-Visby Rules of 1968, the Hamburg Rules of 1978 and, since 2009; the Rotterdam Rules, among others. This justifies a certain progress of the maritime law at international level.

V.2. The Maritime Navigation Code in DRC

The maritime navigation code in DRC consists of some texts of the laws guiding maritime activities in DRC as adopted from 1966.

The maritime navigation code has been kept static while the realities behind its adoption have been changing at a considerable level. The shipping in DRC is international; therefore, also the DRC's maritime legislation should look similar to other countries' legislation in maritime operations worldwide.

V.3. The non-adaptation of the DRC's maritime navigation code versus the existing requirements in the global maritime industry

By nature and definition, the law is dynamic and not static. DRC is a nation with a maritime occupation, three seaports, a guardian at national level, and representatives of foreign ownerships. DRC has registered a considerable number of infrastructures and other maritime facilities such as a maritime beach and a territorial sea stretching out to 12 nautical miles (22,224 km), an intense offshore activity, a multimodal transport system, a well-equipped workforce maritime team not only in terms of skills and qualifications, but also in abundance. With the above maritime status at DRC, the evolvement of different shipping parameters requires the adaptation of the international law



Figure 36:Location of Port of Banana. [38]

As far as the current maritime navigation code in use is concerned, it is silent on the maritime pollution matters and this challenges the DRC when it comes to the determination of responsible persons/ organizations to pay compensation when any maritime incident occurs. Recently, the port of Banana is upgraded to accept international trade. [38]



Figure 37: Banana port in DRC [39]

V.4. The DRC Coastline

The fact that since 1966 the date of the promulgation of the maritime legislation in DRC, the maritime code was silent on some subjects including the coastline; the DRC remains also unable to answer any questions related to its coastline issues.

By that time (1966), it was normal because maritime accident cases were rare compared to the current time where the international maritime legislation follows the international requirements and accommodates all matters, including the measures preventing the pollution by ships via the maritime convention “MARPOL 73/78”.

In addition, the International Convention on Oil Pollution Preparedness, Response and Cooperation, 1990" or "OPRC, 1990" defines the framework for international cooperation to fight against oil slicks through the intervention of other countries party to the convention.

The DRC has been also blocked by not having ratified some of these international conventions which made it unable to vibrate legally at the same level as other countries.

Another challenge is in the navigation sector of DRC, where naval officers and junior seafarers have been well-trained, with good track records in navigating long distances but remain unemployed, simply because the DRC did never ratify the Standards of Training, Certification and Watchkeeping 1995 (STCW95).

The DRC is therefore not on the white list of the IMO. To conclude, DRC’s maritime navigation code does not contain key mandatory elements of the international level related to the training standards for seafarers. DRC is now required to ratify some international maritime conventions to be able to improve this sector and bring it at international standards level. Figure 39 is included for illustration purposes.



Figure 38: Left the Congo River and on your right the Atlantic Ocean [40]

V.5. Post ratification of pertinent IMO conventions

To allow maritime industry to become competitive with an improved service in the field in DRC, there is a need for amendment of the international navigation code in this country. The international maritime conventions to be ratified by DRC together with its local strategies in the maritime area shall constitute the basis of such amendments.

V.6. IMO and International Maritime Conventions

As introduced previously, the International maritime conventions are elaborated to the level of two specialized UN agencies such as the International Maritime Organization (IMO) which deals with all matters related to safety at sea, prevention of pollution and the training of seafarers and the International Labor Organization (ILO) which on another hand deals with all working conditions on ships related issues. Shipping is as of now an international activity; therefore, it is important for all maritime countries to have same understanding on it by ratifying common conventions and make them enforceable on all common seaports and territorial places.

V.7. Ratification of maritime conventions in DRC

With a maritime occupation, three large seaports, a guardian at national level, a maritime beach and a territorial sea stretching out to 12 nautical miles (22.224 km), a well-equipped workforce maritime team, and a strong maritime and an offshore activity, the DRC should not remain far from the international maritime law. Ratification of the relevant IMO Conventions is a need for DRC.

DRC will need to review all IMO existing conventions and adopt those which can provide advantages to its maritime activities as a country. Benefits from ratifications are multiple and beyond economic ones, it gives to the country an international vocation to carry out maritime activities at the same level as other countries across the world. With the ratification process, it is not necessarily to ratify all conventions at the same time; there is an option to consider priorities.

V.8. Maritime Conventions require ratification with urgency

So far DRC has ratified the following 6 out of the 59 IMO conventions and protocols:

- IMO Convention of 1948;
- SOLAS Convention 1974;

- LOADLINE Convention 1966;
- COLREG 1972;
- STCW 1978;
- LONDON CONVENTION 1972

Carrying out maritime activities in DRC requires more than that, with regards to convention ratification.

Here below we recommend other six international maritime conventions and protocols for ratification with urgency for maritime activities and the maritime workforce team in DRC:

V.9. Amendments of the GMDSS, ISM and ISPS to SOLAS 1974

SOLAS 1974 is ratified by DRC among other few conventions already ratified by the DRC. The latest version of SOLAS after its amendments related to GMDSS, ISM and ISPS needs to be incorporated into the law.

V.10. STCW 95 (Standards of Training, Certification and Watchkeeping 1995)

This STCW 95 convention has replaced the STCW 78 convention in February 2002. It explains the criteria on standards for training the maritime workforces, exit certification, and how conducting monitoring on ships, the selection and choices of the training providers, centers, trainers, etc.

Periodically, the IMO prepares the so-called white list containing all countries complying with the STCW 95 criteria and whose seafarers who can be easily hired by different ship-owners worldwide. Of course, those who do not comply with the criteria are obviously blacklisted.

Appearing on the white list does not mean that you have already ratified the STCW95 convention. No, making a commitment by sending your dossier to the IMO demonstrates your effort as a country to comply with the convention.

V.11. MARPOL 73/78

The protocol of 1978 which amended the MARPOL 73/78 International Convention has made it the most important one concerning the Prevention of Pollution from Ships of 1973.

Therefore, these are two conventions united and are known under the name of MARPOL 73/78.

Once DRC wants guaranteeing a better environment on its beaches and seaports (in MOANDA) and punishing any boat that does not, it needs also to prioritize the ratification of the MARPOL 73/78 convention.

What will be the benefits of ratifying this convention? Once ratified, one of the important benefits will be the increase of new jobs creation rate.

V.12. FAL Convention

Known as "Convention on Facilitation of International Marine Traffic", the FAL Convention was adopted by the IMO in 2003 with an aim to facilitate maritime traffic between States. Ratifying this convention might give the opportunity to DRC to legislate for the competent services allowing visiting the boats staying on its ports. These services will know exactly which documents to request from the captains of the boat and which information that these documents may contain.

So doing what the international maritime legislation recommends is imperative on the side of the DRC. [41]

V.13. The MARPOL 73/78 Convention

as discussed above, deals with the preventive actions to be taken on maritime pollution prevention.

On another hand, the 1990 OPRC which refers to Oil Pollution Preparedness, Response and Co-operation, 1990; focuses on regulating all technical issues with an aim to combat pollution once such occurs. This involves also a good cooperation between different states on the matter.

Once the DRC ratifies this convention, it will obtain any assistance from other countries which might have ratified the convention in case an oil spill in one of its boarding seas such as MOANDA. This is one excellent insurance coverage because no single country alone can be able to deal with the consequences raised from an oil spill. [42]

V.14. SUA convention

This convention is specifically aimed to eliminate any illegal act on ships.

These may include maritime piracy, terrorism, smuggling and drug trafficking by sea among others. Ratifying such a convention by DRC, would complete or fix a loophole in its law.

Though all other conventions are also important, the six IMO International maritime conventions discussed above are primordial to the DRC for their ratification with urgency once the country prefers to be on the white list of international maritime affairs. Over the time, other conventions, may also be ratified upon the DRC's local maritime strategies.

River and lake transport should, as mentioned above, play the main role in multi modalism in the DRC. The rivers and the lakes should be the extension of the roads to cover the entire national territory if they were better developed and organized.

But to get there, you have to be able to organize efficient navigation on the river and canals.

Speaking of efficient navigation, we mean first of all, the equipment of river ports, and the state of the fleet and also the regulation of this navigation.

The CEMAC / DRC inland navigation code is jointly applied in the DRC and the CEMAC countries (Cameroon, RCA, Congo-Brazza, Gabon, Equatorial Guinea and Chad). The code has been very well designed and monitoring the application of its articles can go a long way to improve navigation on the Congo River and its tributaries. [30]

To better understand the size of the Congo River basin and its economic impact on the countries whose territories are part of this basin, let us first

examine the large basin formed by the Congo River and its tributaries Ubangi and Sangha. The International Commission of the Congo-Ubangi-Sangha Basin or CICOS brings together the governments of DR Congo, Congo, Cameroon and CAR. It has its headquarters in Kinshasa.

The Congo-Ubangi-Sangha basin is located in Central Africa and is made up of a vast area of dense and humid forest with an important hydrographic network. There is therefore a first interest: the ecological and environmental interest for the regulation of the ecosystem, not only for African but globally as well.

Because of its geostrategic position, this basin could be the spearhead of intense multimodal activity for all of Africa.

Indeed, its 3 major terminals can easily be connected to the mainland road network:

- The CICOS terminal in Bangui serves as a connection with the Bangui-Douala axis and the Bangui-Ndjamena road:
- The Kinshasa CICOS terminal connects CICOS to the eastern part of Africa through Kisangani and the road to Mombasa:
- The Ilbo terminal is ensuring on the one hand the interconnection between the CICOS countries, and on the other hand a connection with various road axes through the corridors of the CICOS countries.

As it have been shown, the navigable network of the Congo River and its tributaries is 25,000 km in its natural state. But this network requires maintenance and development.

There have been tripartite agreements between the DRC, the Congo and the CAR concerning the modalities of this initiative.

By referring to CICOS publications, several difficulties hamper the maintenance and development of the navigable network of the Congo River and its tributaries (extracts from the CICOS website):

- The mismatch between the resources made available to maintenance services and the scope of the work to be performed.
- Obsolescence and insufficiency of the easement units (dredges, beacons, hydrographic launches);

- Insufficient dredging or marking.
- Silting of ports at Pool Malebo (Kinshasa and Brazzaville);
- Decrease in water bodies on the Ubangi (currently 8 out of 12 months of navigation);
- Presence of the Zynga rock threshold 60 km downstream from the port of Bangui.
- The units are operated without respecting safety standards.
- The flight crew is aging and underqualified.
- The only training center in the sub-region has been closed for over ten years.
- A captains' training project, with the support of French cooperation is underway.
- No communication system is organized between the boats and the administrative staff on land (Notice to mariners, assistance, rescue, etc.).

This inventory of the navigable network of the Congo River and its tributaries gives a clear idea of the action plan to be developed to make the Congo River play the role of the engine of economic development, not only for the DRC but for all countries in CICOS, i.e., in the Congo-Ubangi-Sangha basin.

V.15. The fleet on the Congo River and its tributaries

Based on a CICOS study [30] the Congo River Basin and its tributaries have an estimated fleet of 10,000 watercrafts, mostly owned by the private sector. However, CICOS currently only has data relating to 4,125 watercrafts.

All this fleet is used for the transport of goods. Logs, oil, live cattle and agricultural products are mostly transported. We, therefore, understand the extent of the work to be done to register all these watercrafts with the river authorities of the CICOS countries, including the DRC. With the registration, they will have data on the units to monitor their navigability in the river and its tributaries as well the same in all waterways inland.

VI: Summary of the research and Conclusion

During the early and mid-1900s, maritime transport had become the regular and commonly used means of transport in Congo DRC. As such, the Congo DRC and the port services deployed many passengers and goods steamer vessels mainly on the Congo River and its tributaries, the lake Kivu, other lakes and rivers in the area and into the accessible section going into the Atlantic Ocean.

However, the maritime transport system did not develop much particularly due to the war which resulted in the destruction of the transport infrastructure which has only further deteriorated gradually due to the lack of further investment.

Until recently, Onatra operated different barges, ships and ferries in maritime operations between the ports from the inland to the international ports leading to Congo Brazzaville to the Central African Republic through to the Congo River and the lake Kivu, which is connected to Rwanda and Burundi.

However, in the Congo DRC, the inland maritime transport is recognised from its outdated vessels, insufficient landing infrastructure and mismanaged supervision and monitoring. Furthermore, the management is considered incompetent and corrupt. The major challenge needed to overcome the aforementioned issues pertains relating to improving the condition of rivers and lakes and reconstructing the landing site facilities. In addition, there are more challenges in terms of adding more vessels and the requirements relating to the improved implementation of safety standards.

VI.1. Summary Analysis of Findings

These research findings are based on discussions that coordinate with the research's methodology used in this study, as illustrated in chapter III of this paper.

They involve the inland transport infrastructure in Congo DRC, which is categorized by old and indigent vessels, inadequate landing provision, and disorganized supervision.

The use of modern and technologically advanced vessels could be a more sustainable maritime transportation method as it may be helpful in reducing the entry costs to coastlines and operational costs for distant shores of the DRC waters including access to the communities settled along the inland waterways.

There are several kinds of maritime accidents including

- Cruise and passenger ship disasters,
- Fishing vessel accidents,
- Tugboat mishaps,

- Crude oil tanker, and cargo vessel accidents,
- Drug and alcohol-related maritime accidents.

The management of the maritime industry in the Congo DRC is observed to be unorganised, chaotic, outdated and based on the individual preferences of the vessel owners.

It is recommended to have a legal framework pertaining to the maritime industry that can ensure that the private vessel owners do not abuse their powers.

In the absence of such a framework, the private owners will always try to maximise their profits at the cost of safety of the passengers and crew. Literature review has revealed that since 2008, there has been several accidents in the waters of Congo DRC relating to the lack of sufficient maritime safety standards. The existing requirements are generalised ones that apply to all the vessels whether new or old, which are poorly maintained. In addition, there is a lack of specific requirements related to passenger and cargo vessels. This leads to an unclear legislation which particularly affects the work of inspectors and auditors who do not know what they should be looking for during inspections.

The requirements, as per the ordinance law N° 66/96 of May 14, 1966. in the Congo DRC, state that all the vessels shall be tested, registered, and recognized as seaworthy before they are put out in the sea. The 1966 law defines a boat as "any vessel of 10 gross tonnages or more, intended for the transport of people or things, fishing, towing, dredging, or any profitable navigation operation." This law has never been implemented and is out of date. That law does not establish safety requirements or abilities for vessel operators. **Invalid source specified.**

Most of the maritime accidents in the DRC waters, including those relating to the small boats, whether known or unknown, goes unreported by the owners due to the lack of registration number.

It is recommended that strategies to improve the maritime safety should be implemented by establishing standards relating to vessel construction, policies to adopt these standards and having a legislation in place to enforce the implementation of the standards.

The main causes of the maritime accidents in the Congo DRC are identified as:

- overloading of the vessels with passengers and goods,
- poorly constructed and maintained vessels,
- insufficient vessel engineers and crew,
- outdated sailing practices,
- lack of navigational systems,
- lack of life jackets on the vessels,

- poor visibility, outdated communication system and bad weather,
- lack of rescue boats,
- insufficient supervision and inspection

It is recommended that the government in collaboration with the Ministry of Transport, introduce and implement strategies to reduce the accidents in the waters of Congo DRC. In addition, there should, be more competent crew members with the knowledge of maritime industry and competent to handle operation of landing sites, including emergency preparedness.

The "Direction de la Marine au Congo DRC," or the Maritime Directorate, is encouraging working on a Waterway Transportation System for improving safety. Furthermore, The International Maritime Organization (IMO) has begun working with the Congo DRC's maritime shipping department for marine development.

It is also observed that the life jackets to be used on the vessels during emergency are expensive going up to 75,000 (approximately 31 Euros), however, the cheaper ones that come at less than half the price mentioned above at 35,000 FRC are weak and gets easily damaged during heavy winds. Crew and passengers also lack headlights making it difficult to see during the nights.

The current regulatory regime of the maritime department in Congo DRC is inefficient and unable to effectively address the safety concerns related to maritime transportation in the waters of Congo DRC.

A lack of coordination and organisation is observed between the Ministry of Transport and the other parties related to maritime transportation in terms of cooperation during maritime accidents in the Congo DRC. This is also true when it comes to the implementation of CICOS/CEMAC agreements and other emergency regulations for prevention of maritime accidents.

VI.2. Conclusions

The research carried out as the part of this master thesis over the past few months has concluded that the management of the maritime industry in the Congo DRC is unorganised, chaotic, outdated and based on the individual preferences of the vessel owners. The forms of management are also based on the lack of concern by the private vessel owners. The number of maritime accidents in Congo DRC has increased as a result of this mentality.

It can be stated that the vessel owners, even though they carry out passenger and goods transport via Congo DRC waters, are not fully aware and do not take responsibility of passenger safety and securing the goods. The private vessel owners exploit the waterways by disobeying the maritime transport regulations in force in the Democratic Republic of Congo. Note that all the mixed transport vessels that operate in the waterways of Congo also pose a major risk of fire accidents during the navigation.

It is evident from the research on maritime safety in Congo DRC waterways that water transport regulations are unreliable and poorly implemented. Some of them are out of date. Introduction and implementation of a powerful maritime legislation in DRC is needed to address the occurrence of numerous mishaps in Congo DRC waterways.

In addition to the above, the outdated rules and regulations do not provide legislation for sufficient manning of the vessels, overloading of passengers and goods, educating the incompetent and untrained crew members. The use of old vessels, outdated and lack of navigational charts and systems, reverse voyage strategies and inexperienced vessel construction workers are some of the leading factors causing maritime accidents in DRC.

The maritime management and safety requirements should be modified, and the maritime transport rules of the Congo DRC should be standardised. Furthermore, financing for transportation management is severely insufficient and needs proper expansion, particularly in the maritime transportation system.

The authorities in-charge of monitoring water transport in the Democratic Republic of Congo (DRC) encounter a number of difficulties. These include, for example, widespread notions that water transportation is poor, outdated, and only suitable for the underprivileged people of the region. Institutional prejudice in the sector gives the impression that water transportation is an unsustainable means of transportation. Besides, inadequate safety requirements from institutions lead to environmental problems including oil spills, toxic gases release, and the spread infectious disease. This also results in inadequate navigation systems, and crews that are under-trained or inexperienced. These issues are mostly the consequences of out-of-date legislations which are not being followed by the authorities. Improvement of the maritime transport industry, as well as improved rules and requirements are recommended for in the maritime sector of DRC. Increased investment in the maritime industry in Congo DRC, will help overcome the aforementioned challenges and revitalize it.

Finally, it is can also be concluded from the research, that small vessels are involved in the majority of the maritime times accidents in the Congo DRC waters. Therefore, it is crucial, for the overall safety that the authorities address all the issues mentioned above while focusing on small boats when establishing maritime safety requirements, ship construction standards and legislation that enforce those requirements and standards.

VII. Recommendations

The researcher has got the impression that waterways navigation in Congo DRC is categorized by old and uninsured vessels, poor landing facilities, missing of waterways mark, lack of communication system, navigation

system and updated chart navigation map and negligence to implement transport legislation and update them according to CICOS/CEMAC collaborating with IMO.

To reduce the risk of accidents in the maritime transportation sector in Congo DRC, the following is needed to be done:

- a) Obtain insurance coverage for all ships.
- b) Repair all infrastructure at the water landing points.
- c) Increase the number of vessels according to standard-construction.
- d) Increase vigilance to safety laws and see to that they are applied.
- e) Implement firefighting systems

The sectors listed below are suggested for improvement to reduce the number of maritime transportation accidents in DRC.

V.1. Maritime Administration

Maritime management cannot be successful without being organized, including co-operation between the authorities and ship-owners in order to avoid the risk and incidents which cause accidents in maritime transportation.

Strong national maritime administrations are beneficial because they demonstrate a willingness and ability to enforce national and international safety laws and conduct national and international vessel inspections.

Controlling and ensuring the safety standard of shipping with flag and registration is the responsibility of the maritime administration.

In the Congo DRC, to develop a marine administration that will be able to administer and supervise matters relating to the safety of life, health, property, and the environment on Congo DRC-flagged ships as well as international ships operating in Congolese waters, is a matter of urgency.

Because the IMO has demonstrated that there is an issue with fraudulent ship registration and registry operation, this could be an excellent opportunity for the administration office to take responsibility for assuring the legal protection of DRC-registered ships and registered rights for those ships.

For maritime transportation in DRC to get good safety management a good quality management is needed. In order to achieve this, the follow factors are needed.

- Implementation of quality management standards in the maritime sector in accordance with IMO requirements.
- Implementation of safety management codes and their importance.

- Implementation of National and International safety standards.

Safety management is seen as a key to further development. The ship's owners need to be the starting point for safety work characterized by strong involvement of all employees, Figure 1. Every element of a safety management system is supported by a set of goals that underlie the development of plans, procedures, processes, standards and guidelines to improve better safety.

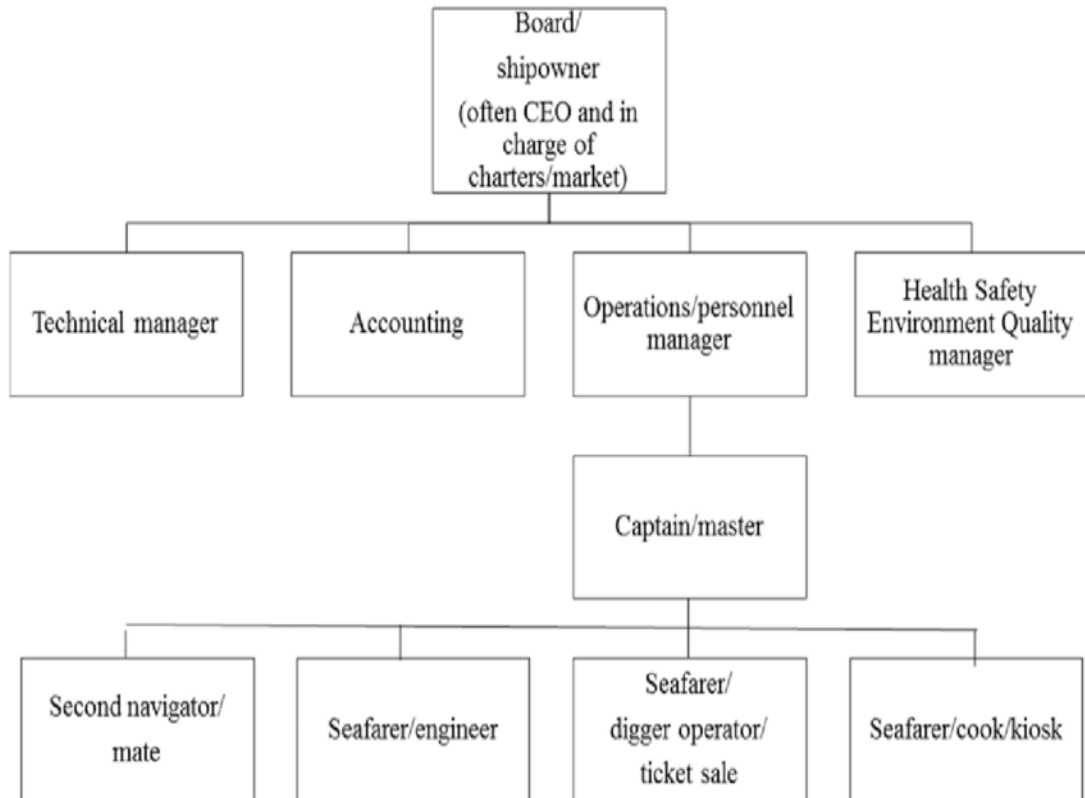


Figure 25: Organizational structure https://www.researchgate.net/figure/Common-organizational-structure-of-a-Norwegian-coastal-ship-owner-office-and-vessels_fig1_325967604/download

Figure 1. Organizational structure

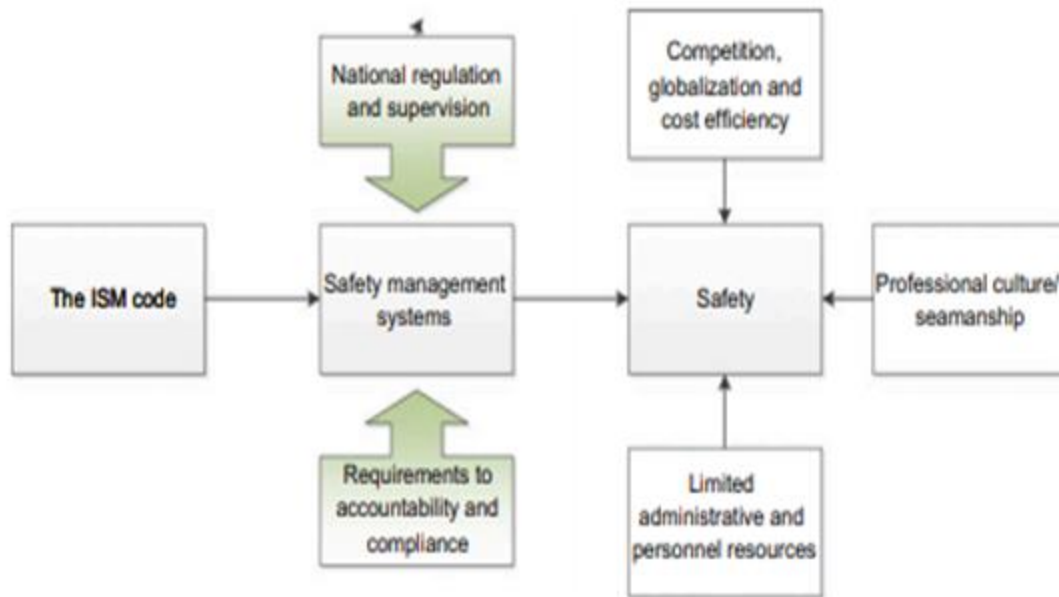


Figure 39: Safety management structure

Forces that after the regulation before the regulation can affect safety management

VII. 1.1. Implementation of safety management

Safety is a fundamental value in the organization. The concept of safety management (Figure 2) is described in the maritime industry as identifying and controlling risk in order to ensure safety at sea, prevent personal injury or loss of life and avoid damage to the environment or property. (Stolzer, 2008)

Safety management is represented by systematic activities to achieve and maintain a level of safety in accordance with the objectives and requirements an organization has set itself (Aven, 2004)

A safety management system should be based on the International Safety Management Standard (SMS). The SMS gives maritime industries information about the factors and aspects to improve maritime safety.

Those factors are:

- Technical solutions
- Training and competence (i.e. human factors)
- Workplace conditions (i.e. ergonomics)
- Management and organization
- Risk-based planning and design
- Long-term perspective
- Customer orientation
- Leadership involvement
- Continuous improvement
- Fact-based management
- Employee involvement at all levels

- Good relations with subcontractors
- Corporate responsibility
- Good and effective health, safety, and environmental policies.

Safety Management is based on Total Quality Management. Pg.470 (Kristiansen, 2005) Central to the TQM philosophy is the so-called 'plan/do/check/review' loop (Figure 3), in which quality is improved on a continuous basis.

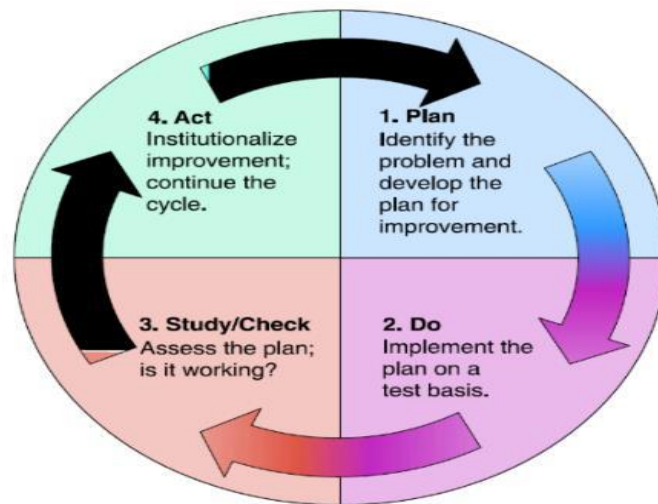


Figure 40: Total Quality Management Loop

Figure 3 Total Quality Management Loop

The organizational safety level can be managed through the use of a set of basic safety management activities. The five basic components in the safety management system (SMS) in Figure 4 below, which is heavily influenced by TQM, are as follows:



Figure 41: The five basic components in the safety management system . [9]

The safety management system will help to measure the shipping companies' performance and identify areas for improvement, as well as implement new solutions where necessary. In this work, the revision phase is crucial for continuous development. According to (Stolzer, 2008), consistent use of audits is one of the most important factors for continuous development. In the audit part of a safety management system, corrective and preventive measures must be taken and followed up to improve compliance with the company's guidelines (Batalden, 2012). A safety management system shall include both internal controls to ensure quality, as well as general control systems and continuous monitoring.

(Stolzer, 2008) accounts for elements in robust and effective safety management systems through the four phases: ***policy, risk management, safety audit and safety culture.***

- The first phase of safety objectives is often referred in the technical language as a safety policy. In this phase, overall goals are established to deliver results in line with the expected plan. In the risk management phase, it is important to define goals or policies that describe the level of safety the shipping company must maintain.
- The second phase of risk management concerns the importance of a good risk identification system in order to be able to manage risk. This can also be seen as the practical implementation phase. Here, the plan is implemented and processes are carried out at the same time as data is collected for mapping and analysis in the next two phases (Stolzer, 2008). In this phase, both the risk analysis itself, determination of risk acceptance criteria, operation of systems and control of current risk must be established (Stolzer, 2008).
- The third phase of internal control is the most relevant for our task. An organization must incorporate regular audits to ensure that safety objectives are met. In this phase, the actual results are studied against the expected ones. (Stolzer, 2008) believes that if internal control is not a routine task in the organization, a safety management system will be of little use.
- The last phase in the model is follow-up and development. In this phase, corrective measures and adjustments are made to improve compliance with the safety objectives (Batalden, 2012). In this phase, evaluations must also be made in relation to whether certain measures work better than others to achieve specific goals (Aven, 2004). This phase also addresses organizational learning as an important part of a security management system.

The Safety management system provides organizations with an effective framework of security philosophy, work tools and methodologies to improve, understand, construct and proactively manage safety systems (Stolzer, 2008).

A system is a mixture of people, procedures, processes and equipment that is integrated to perform a function or activity within a given environment (Stolzer, 2008). According to (Hale, 2003), a safety management system takes

place at the three system levels (Figure 5); **1. Operator, 2. Procedure and 3. Policy.**

- Operator level are people at the sharp end who are in direct contact with risk during operations.
- Procedure level is the documents in a safety management system, it contains plans and procedures that are used to improve, guide and optimize risk management at the operator level.
- The policy level can also be referred as the structure level, here it is checked that operations and procedures take place in accordance with the company's overall goals, at the same time *as* improving operation by further developing the safety management system. In good safety management systems, learning takes place across the levels by capturing feedback and using it to develop the system (Hale, 2003).

The three levels have different time perspectives from seconds to days on changing operations at the operator level, weeks and months at the procedure level while it can take years to develop good policies (Hale, 2003).

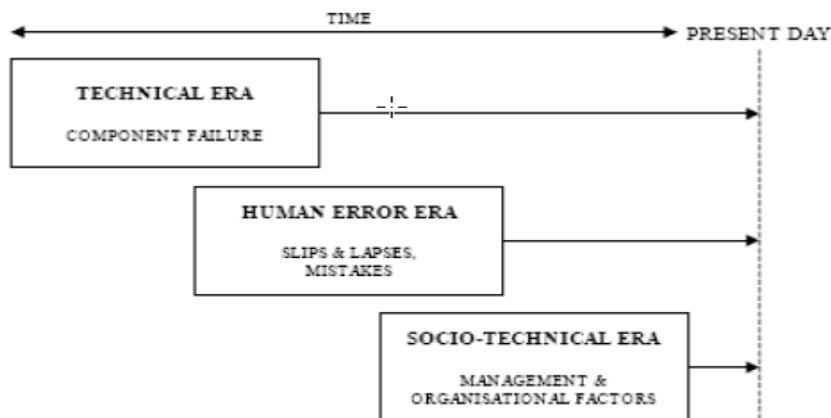


Figure 42: Three ages of safety concerns (Reason, 1997)

Implementation of safety management as it requires in this suggestion, will reduce the risk and incident that causes the accident in Congo DRC waterways.

VII. 1.2 Implementation of the IMS CODE

The ISM Code stands for "International Safety Management Code" or "The International Management Code for Safe Operation of Ships and Pollution Prevention.

Through the ISM Code, shipping companies are required to develop and maintain safety management systems that take into account all identifiable risks associated with their operations. The ISM code is based on a self-

regulatory strategy where the focus is on goals to be achieved rather than descriptive requirements on how to do it (Kristiansen, 2005).

The ISM Code was made to create a better safety culture in shipping and to try make it more easy for shipping companies to operate ships (Tranvåg, 2004), (Dragsnes, 2000).

One of the main objectives of the ISM Code is therefore to focus on safety for those involved on board and on land, including through routines for quality assurance (Pettersen, 2010). The ISM Code has been described as an innovation in safety work at sea, as it for the first time facilitated a holistic approach where one would now focus on the interaction between people, technology and organization (Pettersen, 2010).

According to the purpose of the ISM Code, the aim is to safeguard safety at sea, prevent personal injury and loss of life, avoid damage to the environment, in particular the marine environment, and to property. The rules from the ISM Code, stipulates that companies must develop, implement and maintain a safety management system. This means that the shipping companies themselves have the main responsibility for ships, crew and the safety of the environment. The work must be documented before the maritime authorities, who will check that the shipping companies operate the systems as they state that they do, and that it is in accordance with the ISM Code.

The ISM Code is based on functional requirements with general wording so that it can be widely used. This is because the code recognizes that no two shipping companies are alike, and that the vessels operate under a number of different conditions (Christophersen, 2009). Therefore, the code takes a step away from descriptive requirements and instead focuses on quality assurance and internal control based on a self-regulatory strategy (Kristiansen, 2005).

The ISM Code defines a safety management system as "A structured and documented system that enables the company's personnel to effectively implement the company's policy for safety and environmental protection". This work also includes continuous improvement of the system.

Management is about setting goals, designing measures or instruments as well as monitoring the practical implementation.

The main goal of a Safety Management System (SMS) is to minimize risk, and is an activity that runs in parallel with other activities in an organization (Stolzer, 2008).

Each shipping company in accordance with the requirements of the ISM Code must have a safety management system, a safety management system based on the shipping companies' vision, values and safety goals (Batalden, 2012).

VII. 1.3 Tanker Ships

There has been criticism that the requirements of the ISM-code are not applied properly by Tanker Operators, that is why the Ship industries saw that there is a need for more safe-guards for vetting and chartering above the ISM-Code and SIRE (Ship Inspection Report Programme).

In 2004, Oil Companies International Marine Forum (OCIMF) introduced its best practice guide for “Tanker management and Self-Assessment” (TMSA), as a tool to help vessel operators assess, measure and improve their safety management systems. It complements industry quality codes and is intended to encourage self-regulation and promote continuous improvement among tanker operators.

It is in this context that TMSA aims to be the solution to the so-called systemic problems, has been able to transcend the spirit of the ISM and to be less aware of the information provided by the SIRE Natural Resources Monitoring.

The TMSA program seeks to achieve this by providing clear standards for tanker users, which must be assessed by the makers and presented to the OCIMF for inspection and review. Assistance is provided to users through key elements, the objectives of these key elements are given in guidance documents; Key Performance Indicators (KPIs), and Good Governance Activities (OCIMF), 2004). To review the development, the program outlines 4 “stages” (Figure 6). Each tanker user must report to the OCIMF a "development report card" on the "stage" that has reached him or her in a progressive manner. Reports must be updated whenever the user reaches the top level. Figure 6 below shows a flow chart for key elements implemented through the management system where it works as a guide to the progress (OCIMF), 2004).

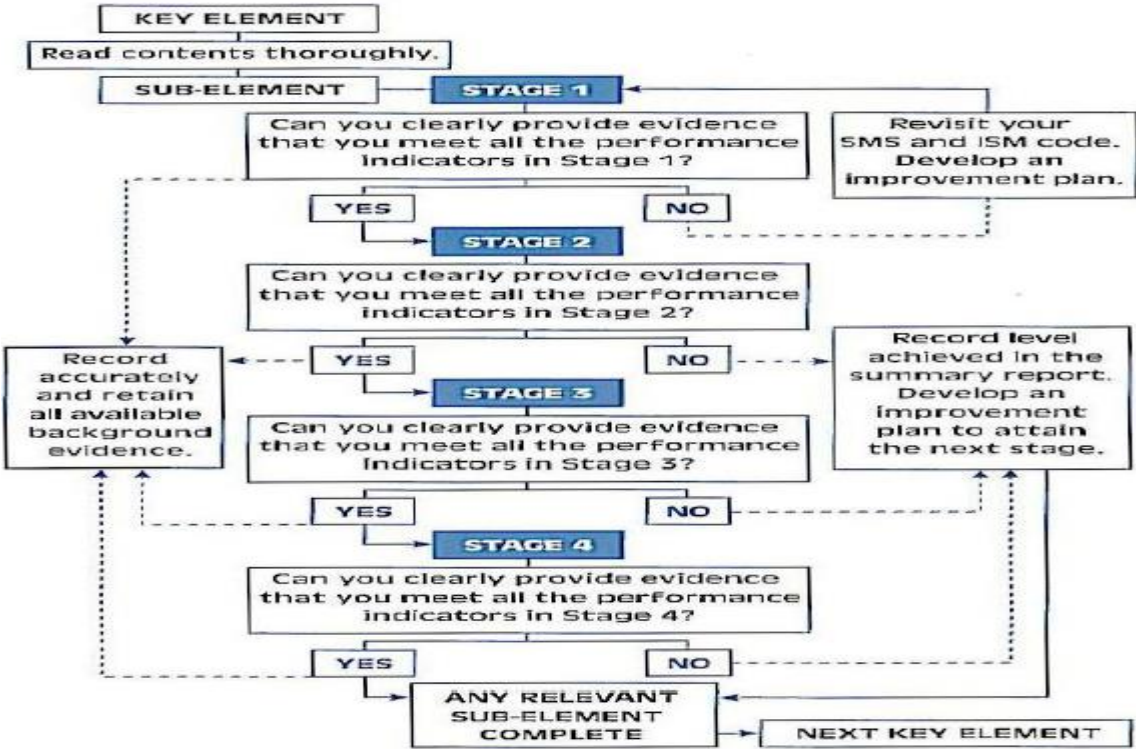


Figure 43: TMSA key steps for the measurement processes flowchart((OCIMF), 2008)

The report should therefore be a sign of the status of the tanker operator in terms of OCIMF regulations on TMSA. OCIMF agrees that these regulations should be revised and updated regularly.

VII.1.4 TMSA's element and their definitions

The TMSA guidelines outline 12 principles or key elements of management performance. These items provide a list for ship users to keep them safe and accessible to the environment.

The difference between the TMSA Code and the ISM relates to the management itself where TMSA not only sets goals that must be achieved but also provides a detailed guideline using key criteria to achieve them. To achieve the goal of the TMSA through the objectives of an element, the program defines key performance Indicators (KPIs). The KPIs are measures against which company can track its effectiveness in meeting its aims and objectives (OCIMF O. C., 2017). KPIs are among the things that help ship operators carry out their ongoing-development programs.

Combining the assessments of a particular ship company to improve their work with the tools they already have to improve and develop their management system, will result to a feedback that will give the company a clear and objective picture of performance

This helps them to identify gaps early and provide direction for closure planning and improvement in the future.

Companies should work through the 12 key elements and match their SMS to the KPIs with the form levels. The higher the level match, the closer they are to fully meeting the objectives of that element (OCIMF O. C., 2017).

The TMSA will help the shipping companies to improve their systems of organisation and management. This guide encourages them to estimate and assess the level of safety of their systems in relation to the predetermined Key Performance Indicators/KPIs; that is, it provides them in this way with a measure of best practices.

The TMSA is based on the principles of the ISM Code, and encourages managers of tankers to check the procedures which relate to safety, quality and the protection of the environment, in pursuit of their continuous improvement. It introduces four levels of assessment, with Level 1 being the lowest and Level 4 the highest. A company which fully implements the letter and spirit of the of the ISM Code should be able to self-assess itself at Level 1. Given, however, that the aim of the TMSA is to encourage the managers of tankers to seek continuous improvement, even if a company is at Level 4, it should not cease to seek the means of further improvement of its processes. Of course, the TMSA is based on the ISM Code, but it includes actions on units which are not connected only with safety management, but also concern quality management in the company, as an assessment of the improvement which has been achieved, procedures for the human resources management systems, the management of changes, etc. are included. At each stage of the grading of the company's performance, key performance indicators are specified, while for each definitive indicator, the relevant best practices are proposed. (OCIMF O. C., 2017).

VII.2 Specific improvements

VII. 2.1 Implementation of life jacket requirement

It is well known that the majority of water transport users in Congo DRC do not wear life jackets. If the Ministry of Transportation could make life jackets mandatory for everyone who uses the Congo DRC's waterways, the number of deaths could be reduced considerably. In collaboration with the Marine Directorate and Navigable Ways, they can design and develop a user-friendly life jacket that is both useful and affordable to everyone.

Life jackets in general are reported to be very expensive for the water transport users and as such, the majority do without them. But the Authority could enforce the ship-owners to improve this life jacket in their vessels as one of the human safety measures on board. For example, in Norway each vessel navigating in Norwegian waters, Figure 7, has life jackets on board designed according to the capacity of people that the vessel can carry, and each life jacket has the maximum kg printed, according to the kg of users. This gives guarantee of safety to passengers to get help or being rescue during a disaster or incident. Implementation and enforce of using the life jackets will rescue several lives of human being in Congo DRC waterways.



Figure 44: Robust life jacket.

Reference: wish net shop

VII.2.2 Implementation of navigation system

VII.2.2.1. Improving sea chart

Nautical charts are a key to safe navigation.

A nautical chart is one of the most fundamental tools available to the mariner. It is a map that depicts the configuration of the shoreline and seafloor.

It provides water depths, locations of dangers to navigation, locations and characteristics of aids to navigation, anchorages, and other features. The nautical chart is essential for safe navigation. Mariners use charts to plan voyages and navigate ships safely and economically.

A chart is a great option as a source of facts and an instrument for all maritime trade. This should include all of the information needed for direction updating and journey choosing, as well as avoiding hazards and ensuring the safety and ease of route planning. Other naval books must collect details that cannot be shown on charts. Below, Figure 8, there is example for nautical chart.

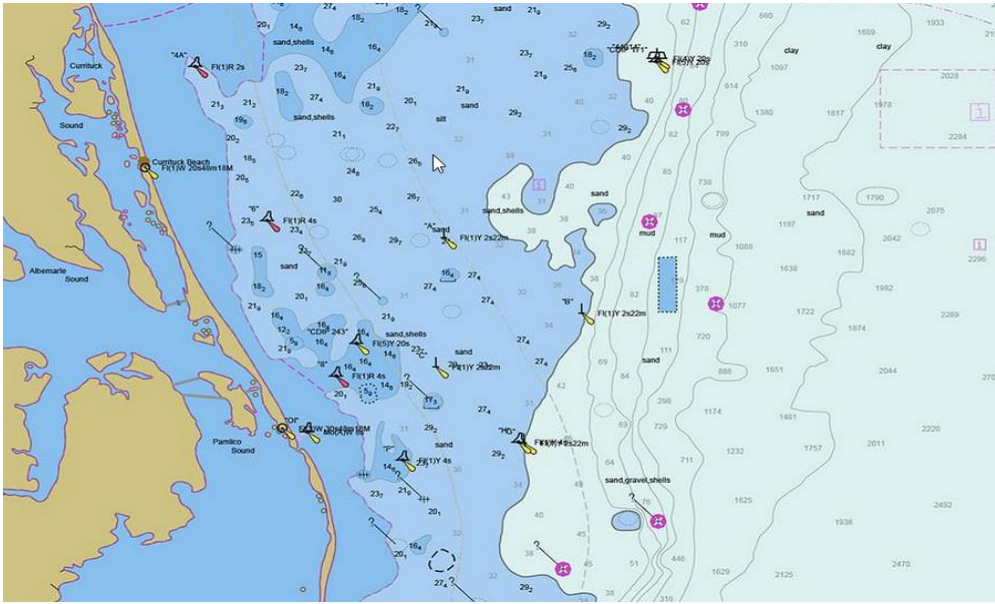


Figure 45: NOAA's Office of Coast Survey (USA), part of the National Ocean Service, is the nation's nautical chart-maker.

Charts as well as other naval papers should be coordinated so that all details are provided on one chart for the area. Normally, the chart is the best way to accomplish details in graphic or symbolic form.

The Congo DRC needs to update the charts in their waterways to improve safety in maritime operations in Congo DRC.

vii.2.2.2 Electronic charts (ENC)

The ENC is a chart that shows all the information needed for the safety of the ship during journey. These electronic maps are designed in accordance with the provisions of the International Hydrographic Organization (IHO) (S-57) to share electronic chart data.

The navigation system will be provided by the ENC, with a coherent framework of the digital charts as well as meaningful positional awareness.

The ENCs are modified on a particular indicator, similar to a map and compass. The maps are constrained by prescriptive data collection demands

(signs, different colours, range of quality, dimensions, and so on) and are particularly needed for operating in multiple national borders.

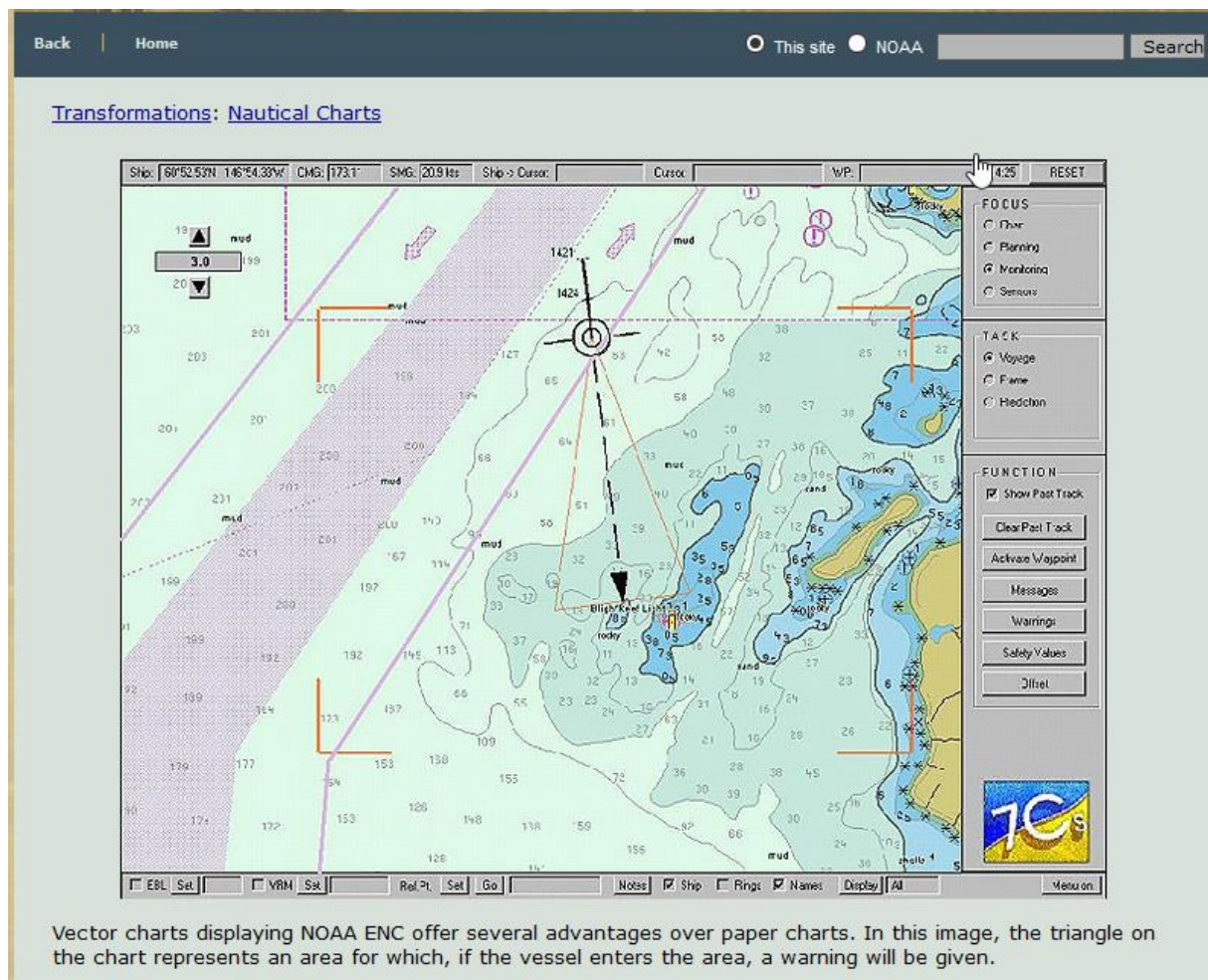


Figure 46: Nautical Charts

https://celebrating200years.noaa.gov/transformations/nautical_charts/image4.html

The details of an ENC (Figure 9) and a map viewer for almost the same location are not always the same. For example, the advantage of an ENC may involve extra detailed information than a paper map, whereas country details and identifiers are sometimes limited.

When main issues arise, such as re-measuring a greater distance, a map cell will be published as a "new version". For workstation factors, "New Publications" may also be released.

In the electronic map system ECDIS, ENCs are used for paperless navigation. ECDIS also displays a continuous display of its own and combination of the vessels' position and orientation.



Figure 47: Electronic Chart Display and Information System & Chart plotters

Reference: <https://scansys.no/sms-products/ecdis-chart-plotters/>

The ENC's (Figure 10) are primarily intended for expert pilots. The expert navy and ships of each dimensions are mandated to navigate authorized maps, which can be in the context of authorised and revised paper forms or an automatic identification and data system for ENC, such as ECDIS (Electronic Chart Display and Information System). Anyone else who navigates using ECDIS is mandated to use the most up-to-date data.

If authorized ENC's have been used and an authorised standby system is in place, ECDIS can be used as a legal substitution for paper maps. This requires that you'll need two ECDIS's on board, each with its own power source.

It is recommended to maritime transportation vessels navigating in waterways of the DRC to establish this system in their vessels to make sure that the safety is increased.

Reference: <https://www.kartverket.no/til-sjos/kart/elektroniske-sjokart-enc>

VII.2.2.3. Markers

Improving of sea marks will rescue life of many passanger and goods during voyage.

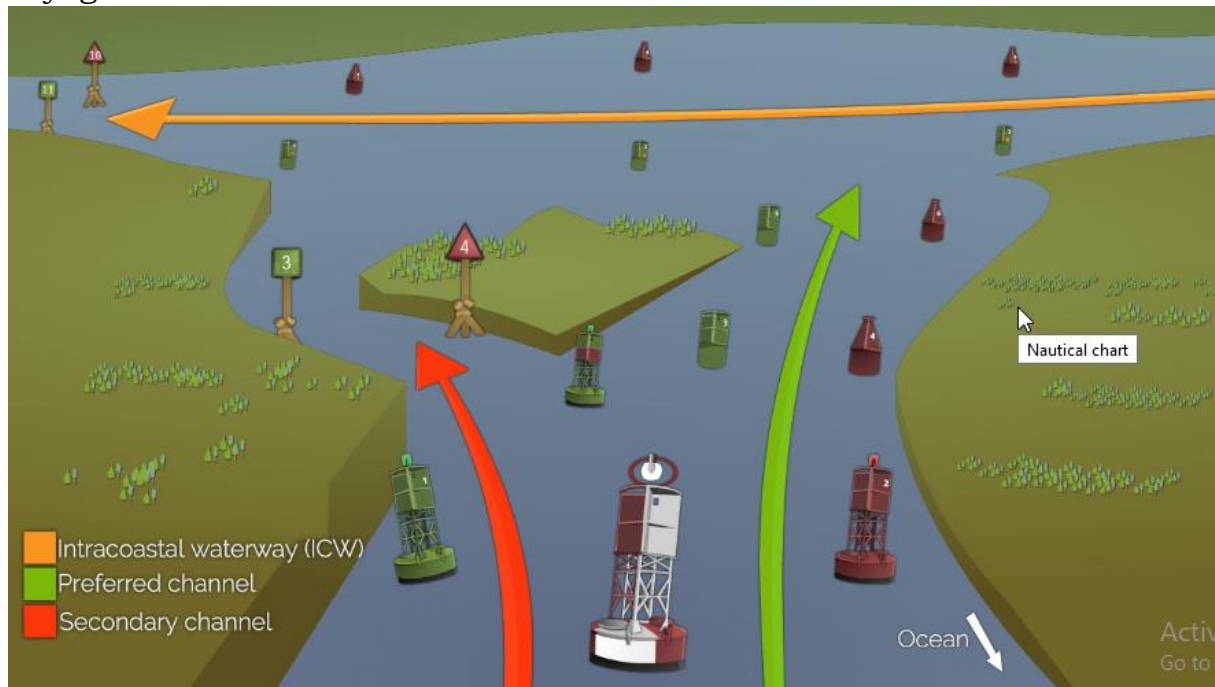


Figure 48: The picture of waterways markers [43]

<https://maritime.college/Buoys-Beacons-and-Marks-National-Maritime-College.php>

From the research, have been found that there is no marks in DRC waterways where even if the world bank had criticized in its report and asking if they can establish them. To establish markers and update them will help the navigation boat to avoid the risk which can appear of hitting rock or sandbank during the journey.

VII. 2.3 Implementation of ship construction and stability standard

SOLAS The main objective of the SOLAS Convention (Safety of Life at Sea) is to specify minimum standards for the construction, equipment and operation of ships (SOLAS, 2001).

VII.2.4 Implementation of fire fight system

Fires that occur on a vessel may spread very quickly to other parts of the vessel due to close proximity of goods packed closely. This is particularly true in the case of old and outdated wooden boats that are extensively in use in the waters of Congo DRC.

Some Fire fight equipment are shown down:



Figure 49: fire-fighting-equipments

Source: <https://www.indiamart.com/proddetail/fire-fighting-equipments-6234409130.html>

Additional unique challenges arise to extinguish the fire due to limited access and hazardous conditions. Therefore, on boats it is recommended that priority is given to fire prevention.

This can be done by ensuring that boat building standards include special provision to address fire safety challenges. Vessels, for example, may be fitted with fire alarm system and a warning system that can alert the nearest port, sufficient fire extinguisher availability on board, standard electrical wiring and providing the crew with adequate training to handle fire accidents and emergency response.



Figure 50: men- tens firefighting

Mention that the most important due to till fire fighting system is to men- tens job, and have regular testing and training.

<https://www.gard.no/web/updates/content/25857263/have-you-remembered-to-fit-compliant-firefighters-radios-onboard>

XVII.2.5. Implementation of communication system

To have communication system in Congo waterways will help the authority and the shipowners to follow and control the operations of the vessel both in good situations or bad situations in order to be able to rescue during the emergency time.

VII.2.6. Life-saving appliances

Life-saving appliances

When ships conduct their business, the safety of passengers and crew should be of paramount importance to the business owners. Therefore, ships must carry sufficient life-saving equipment like lifeboats, lifebuoys, life jackets, life rafts, etc., for passengers and crew that they can use during emergency situations to protect their lives at sea.

According to the SOLAS convention, it is mandatory to carry rescue equipment. A more specific requirements for the manufacturing, testing, maintenance, and record keeping of life-saving equipment is provided by the International Life-Saving Appliance (LSA) Code. The number, capability, and type of rescue equipment vary based on ship size, shipping activities, and voyage. The LSA rules specify minimum requirements that must be met to ensure the safety of passengers and crew.

The international requirements for life-saving equipment according to IMO cover personal life-saving appliances such as lifebuoys, lifejackets, immersion suits, anti-exposure suits and thermal protective aids; visual aids, such as parachute flares, hand flares and buoyant smoke signals; survival craft, such as life-rafts and lifeboats; rescue boats; launching and embarkation appliances and marine evacuation systems line throwing appliances; and general alarm and public address systems.

Source: <https://www.imo.org/en/OurWork/Safety/Pages/LifeSavingAppliances-default.aspx>



Figure: Lifeboat, Source: <https://www.imo.org/en/OurWork/Safety/Pages/LifeSavingAppliances-default.aspx>

To improve the Life-saving appliances in maritime transportation in Congo waterways will reduce risk and incident that occur during the voyage and reach safely to the destination.

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Appendix