2011

Regulating vessel traffic service (VTS) to mitigate maritime accidents at port approaches

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REGULATING VESSEL TRAFFIC SERVICE (VTS) TO MITIGATE MARITIME ACCIDENTS AT PORT APPROACHES

By

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A dissertation submitted to the World Maritime University in partial fulfilment of the requirements for the award of the degree of

MASTER OF SCIENCE
In
MARITIME AFFAIRS

(MARITIME LAW AND POLICY)

2011

DECLARATION

I certify that all the material in this dissertation that is not my own work has been identified, and that no material is included for which a degree has previously been conferred on me.

The contents of this dissertation reflect my own personal views, and are not necessarily endorsed by the University.

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ACKNOWLEDGEMENTS

Balancing the time required to do the research and study at the same time has been a difficult task during the MSc study period.

First of all, I would like to convey my sincere thanks and appreciation to my wife Hala for taking care of the boys (Fares, Mansoor and Hood) while I was here-well done. Also to my family for giving a helping hand to my wife during the study period.

To my brother Mohammed, for his continuous support and mind sharing.

I would like to acknowledge the help of the shipping companies and VTS centers whom were responsive to my questionnaire in order to complete my project-thank you all. The individuals, who have supported, encouraged and critiqued my ideas are many to mention, but some deserve special consideration.

To my supervisor Dr. Jens U. Schröder - Hinrichs, who guided me throughout this dissertation till safe waters.

To my class mate Vivek Menon for sharing his shipping, IT and research knowledge.

To the GOP Chairman, Director General and to Mr. Essa Yateem for nominating me to study at the WMU.

To all WMU staff for the help and caring during my studies in Malmo - Sweden.

Finally, I am indebted to the General Organisation of Sea Ports (GOP) for sponsoring my participation in this MSc course.

ABSTRACT...

Title of Dissertation: **Regulating Vessel Traffic Service (VTS) To Mitigate Maritime Accidents at Port Approaches**

Degree: **MSc**

This dissertation is a study that intends to show how regulating VTS can mitigate maritime accidents at port approaches. Ships (flag State) and ports are not the same nationalities, thus they need harmonized regulations. This thesis aims to identify and analyse different sources regulating the VTS domain at the IMO, IALA and its member States to provide an insight into the way VTS are regulated, and the implication of such regulations on mitigating maritime accidents at port approaches.

Through an explanatory inductive research was carried out using the qualitative research method while utilising a semi-structured interviewing technique and questionnaires plus observations to collect primary data. At the same time secondary data were used to conclude the findings.

The study concluded that risks at port approaches are always in a state of flux and require a proactive approach; regulating VTS functions will eliminate uncertainties and prevent accidents, so there is a need to regulate VTS centres in a harmonized way and to ensure high standard VTS are maintained throughout the VTS domain around the world. Regulating VTS, is an international quest and a national obligation toward protecting VTS stakeholder interests in view of maintaining a high standard of maritime safety. VTS benchmarking / KPI will justify its importance in mitigating maritime accidents within VTS areas and at port approaches. VTS centers are not immune to prosecutions if an accident takes place inside a VTS area due to negligence and due care on the part of the VTSO. This requires a focus on leadership, strategy, internal process, customers and meaning-full ROI in order to yield the desired results.

KEYWRODS: VTS, IMO, IALA, KPI, VTSO, Risks Mitigation, Port Approaches, Legal Liabilities, Regulating, Maritime Accidents.

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List of Abbreviations

ABP	Associated British Ports
AIS	Automatic Identification System
ALARP	As Low As Reasonably Practicable
ALRS	Admiralty List of Radio Signal
AtoN	Aids to Navigation
ATSB	Australian Transport Safety Bureau
CCTV	Close Circuit Television
CDEM	Construction, Design, Equipment, and Manning
CFR	Code of Federal Regulations
CG	Coast Guard
CoC	Certificate of Competency
EC	European Commission
EMPA	European Maritime Pilots' Association
EMSA	European Maritime Safety Agency
EU	European Union
FSA	Formal Safety Assessment
FSI	Flag State Implementation
GMDSS	Global Maritime Distress and Safety System
IACS	International Association of Classification Societies Ltd
IALA	International Association of Marine Aids to Navigation and Lighthouse Authorities
IAPH	International Association of Ports and Harbors
IFSMA	International Federation of Shipmasters' Associations

IHMA	International Harbour Masters' Association
IMO	International Maritime Organization
INS	Information Service
ISO	International Organization for Standardization
KPI	Key Performance Indicator
LPS	Local Port Service
LRIT	Long Range Identification and Tracking
MAIB	Marine Accident Investigation Branch
MarNIS	Maritime Navigation Information Services
MCA	Maritime and Coastguard Agency
MGN	Marine Guidance Notice
MOS	Marine Operational Services
MRCC	Maritime Rescue Coordinating Centre
MSC	Maritime Safety Committee
NAS	National Assistance Service
NGO	Non-Governmental Organizations
NI	National Institute
NOA	Notice Of Arrival
NPA	National Port Authority
NTSB	National Transportation Safety Board
OPRC	Oil Pollution Preparedness, Response and Co-operation
PMIS	Port Management Information System
PSC	Port State Control
PWSA	Ports And Waterways Safety Assessment

QM	Quality Management
ROI	Return On Investment
SAR	Search and Rescue
SMCP	Standard Maritime Communication Phrases
SOP	Standard Operating Procedures
STCW	Standards of Training, Certification and Watch-keeping for Seafarers
TOS	Traffic Organisation Service
TSS	Traffic Separation Scheme
UK	United Kingdom
UKHO	United Kingdom Hydrographic Office
UN	United Nation
UNCLOS	United Nations Convention on the Law of the Sea
USA	United States of America
VHF	Very High Frequency
VHF	Very High Frequency
VIMSAS	Voluntary IMO Member State Audit Scheme
VTM	Vessel Traffic Management
VTMIS	Vessel Traffic Management Information System
VTS	Vessel Traffic Service
VTSO	Vessel Traffic Service Operator
WMU	World Maritime University
WWW	World Wide Web

CHAPTER 1 INTRODUCTION

This chapter will shed light on the subject of Vessel Traffic Service (VTS) and the study to be undertaken while introducing the research outline. Furthermore, VTS general information and background, significance and objectives of the research, research questions, limitations, overview of the dissertation will be presented.

1.1 VTS general information and background

VTS have been around for a long time, from simple local port radar in the 1960s to more organized ones in the 1980s; the increase in number and size (plus increase of ship's speed) of both ships and ports around the world, coupled with commercial demand for information accessibility around the clock, invoked radar (VTS) manufactures to compete for market share by introducing a more sophisticated VTS system that can cater for today's market. The International Maritime Organization (IMO), being the responsible body for maritime safety, realized the importance of VTS in reducing maritime accidents around the world, addressed the VTS issue through SOLAS, Chapter V, regulation 12, while leaving other details to IMO guidelines and IALA recommendations. Many VTS centers are available around the world, the majority of which are seen as a port / traffic coordinator at port approaches just before picking up the sea or harbour pilot to go alongside. Ships (flag State) and ports are not the same nationalities, thus the need for harmonized regulations. Ships are regulated via IMO conventions, but the problem is the VTS around the world. Currently some countries follow IMO guidelines issued through Resolution A.857(20) of 1997, while others apparently follow simple administrative arrangements. The recent grounding of the motor tanker "Maria M" just outside Gothenburg VTS area in 2009 and the grounding of MV Alva on 17th August 2011, bring about the question of "could the VTSO intervene in this instant to prevent the grounding? or leave it, because it is outside the VTS areas. The officer is in the dilemma of what if something goes wrong? Regulating such uncertainty will bring about the desired change towards mitigating maritime risks.

1.2 Significance and objectives of the research.

Maritime administration are seeking risk mitigation options to keep maritime accidents under control. Having VTS hardware is not sufficient to realise its full potentials. The research will highlight the shortfall of having harmonized regulations regarding the implementation of VTS around the world especially in the new era of ports' privatization. The term "world class port" is sought to include having a VTS, yet developing nations are apparently unable to regulate such vital safety element, while the private sector is more cost conscious when installing a VTS that meets the concession agreement and lacks the State expectations / obligations. In most cases, it is left to the operating companies to run the system without due regard to Port and Coastal State obligations as set in the relevant conventions. The matter is so confusing in emerging markets (ports), which focus only on the commercial aspects of the port, rather than on the maritime safety aspects at port approaches, which could be too costly for a company to take on; furthermore, this is a state's problem in the first instant.

Nevertheless, national and international oil companies are exceeding the requirements of a VTS as set in the relevant instruments, yet they apparently act without a national regulatory framework in place, especially in some Middle Eastern and developing countries. Some states will keep marine operations under their arm while others will include them in the concession package to make it more attractive for investors. In both cases, there are many assumptions in regulating the VTS, which has unfortunately been bridged by the VTS equipment manufacturers (similar to IACS role) which will cover operational and technical matters.

Regulating VTS will in no doubt assure the ships' master of his obligation with regard to measures taken to mitigate risks during port approaches. This will also assure others of the State commitment towards implementing IMO instruments as audited via Voluntary IMO Member State Audit Scheme (VIMSAS). Oil companies (national or international) or major ports operator working in a State cannot work in isolation from the State

regulatory system. The State (Maritime Administration) must have an integrated system to cater for all VTS (costal, port or TSS) under its jurisdiction to ensure that a safety-net is created to mitigate the risk of a maritime accident.

This thesis aims to identify and analyse different sources regulating VTS (technical/operational and legislative) at the IMO, IALA and its member States to provide an insight on the way VTS are regulated. Furthermore, the study will examine current methods of managing ship traffic movements around the world, and maritime accidents involving VTS interaction with ships. The overall objective of this thesis is to highlight the way VTS are regulated by international bodies namely IMO and IALA, and also the implication of such regulations on mitigating maritime accidents at port approaches. The research will enhance the researcher's VTS knowledge, at the same time enrich the researcher's ability to follow today's maritime safety trend in the field of VTS regulating. This research can be very useful in developing a conceptual regulatory framework for VTS centers in quest of maintaining high maritime safety standards.

1.3 Research questions

In order to have a systemic approach, the research will be looking for answers to the following questions:

1. *What are the risks that need to be mitigated in areas of port approaches?*
2. *How can VTS (operators) be involved in accident development and what is their liability?*
3. *Are there any KPI or benchmarks for VTS to be regarded as good for mitigating maritime accidents?*

Answers will be sought to the following questions among others;

The first question will study and analyze the risks/hazards which need to be mitigated at port approaches as perceived by the study participants and the author's experience.

Although, certain risks are easy to spot, others may spring out from accidents analysis and individual experience. However, it is also essential to point out that the study will not carry out a "risk assessment" study. The information will be a help in showing how different competent VTS authorities around the world mitigate such risks.

Question two, will examine how a VTSO can be involved in an accident development instead of preventing it. How participants feel about the VTSO being responsible about his actions including court case regarding the same will be examined.

Question three, involves finding out how VTS are actually classified by the stakeholders, namely ship masters and competent VTS authorities.

1.4 Limitations

There are a number of limitations to the present study, which are as listed below:

- The main problem is the extent of willingness on the part of the participants to share information. To deal with this problem, all questionnaires were made general without names to ensure confidentiality.
- Interviews are considered to be one of the most appropriate means of collecting data regarding the research question. However, because of the time frame and the ongoing course study, it was left to opportunities (field study trips) more than arrangement. It is time consuming and may pose a problem to the participant especially around the issues of confidentiality.
- There is little information available about VTS systems in developing countries; World Maritime University (WMU) attending students were asked to help in collecting information about their countries.
- There was a lack of available books (up to date English VTS books) at WMU, so this problem was solved using e-books and relaying heavily on the internet.

The low response rate and resulting few samples have severely affected the general ability of the conclusion that can be drawn.

1.5 Overview of the dissertation (Chapters' summary)

This dissertation consists of seven chapters; the summary details are as follows:

Chapter 1, describes the background of the study and includes introduction, significance and objectives of the research, research questions, limitations, overview and structure of the dissertation.

Chapter 2, gives a contextual background to the relevant literature underpinning the dissertation subject to develop a conceptual frame work for "Regulating VTS to mitigate maritime accidents at port approaches". It includes identification of risks/hazards at port approaches, layers of regulating VTS and the relationship between maritime accidents and VTS actions in the eye of courts.

Chapter 3, gives an overview of the important features of the research design and methodology used which includes identification and criteria of sample (participant), sources of data collection, instruments used to conduct the research and data analysis procedures.

Chapter 4, discusses the participant profile, and summarises the study findings (questionnaire results) in a tabulated as well as in descriptive forms, while connecting the data collected with the theoretical framework. The research questions answers are found in this chapter.

Chapter 5, gives an account of the conducted interviews in a summary format.

Chapter 6, discusses the observations and the results of each research question.

Chapter 7, wraps up the dissertation by discussing the conclusions to each research question and its implications to VTS. It also includes the researcher reflections on the outcome results, as well as recommendations on the best way to regulate VTS based on contextual background, findings and benchmarks from around the world. The chapter also lists the references used together with appendices.

CHAPTER 2 CONTEXTUAL BACKGROUND

2.1 Introduction.

There are several streams of literature related to the research. However, only the relevant literature will be given in this chapter to demonstrate the conceptual framework of the present study, in order to develop the background information necessary for the interviews, designing the questionnaire and be able to understand how VTS are regulated around the world to best mitigate the risks of maritime accidents in port approaches. To achieve this, relevant up to date literature pertaining to VTS structures and functions, risks/hazards and types of maritime accidents at port approaches, layers and elements of regulating VTS, relationship between maritime accidents and VTS will be illustrated in this chapter. Much of the work on the subject of VTS has been done by IMO, IALA, academics, successful maritime administration and consultants. However, there are few that have raised the issue of international regulations of VTS in pursuance of safer port approaches. VTS related IMO and IALA documents, conference proceedings, peer reviewed journals, ports' VTS manuals, text books, research reports, seminars, periodicals, and internet web sites were used to successfully guide the research through.

2.2 Overview of VTS structures and functions

The International Maritime Organization (IMO), being the responsible body for maritime safety, realized the importance of VTS which have made a valuable contribution to safety of navigation, improved efficiency of traffic flow and the protection of the marine environment, thus reducing maritime accidents around the world. The Safety Of Life At Sea (SOLAS) Convention, Chapter V, regulation 12, addressed the VTS issue in its generic format, while leaving other details to IMO guidelines (Resolution A.857 (20)) and IALA recommendations.

2.2.1 VTS definition

VTS is defined as "a service implemented by a competent authority, designed to improve the safety and efficiency of vessel traffic and to protect the environment. The service should have the capability to interact with the traffic and to respond to traffic situations developing in the VTS area" (IMO resolution A.857(20)). SOLAS, urges all contracting governments planning to establish a VTS, to follow the guidelines developed by the IMO, and to also endeavour to secure the participation and compliance with the provision of VTS by ships flaying their flag.

Koburger, (1986) suggests that VTS may also be called Vessel Traffic System, or Vessel Traffic Management (VTM), the name has been further changed subjective to the capability and sophistication of the system where it is been called Vessel Traffic Management Information System (VTMIS) or VTS and Port Management Information System (PMIS). Whatever the name is, the main concept of VTS remained to be defined as " an assortment of personnel, operational procedures, equipment, and regulation, implemented by a competent authority, assembled for the purpose of marine traffic management in a given body of water". Thus achieving the ultimate goal of mitigating the risk of maritime accident. This has been complemented by method of enforcement including fines and judicial proceeding for contravening certain conventions with the collision regulations being the top one (e.g. Dover Strait, UK). Conceptual framework is common because every VTS will be different and the complication will vary according to its type, functions, location of the area it covers and available resources.

2.2.2 Components of VTS

For a VTS to function in its simplest form, there are essential hardware that need to be in place, namely Radar and Communication systems (VHF, telephone, fax) and an office (may be a tower). The evolution of VTS since its inception during the 1980s brought about some compelling needs to keep abreast with shipping and transport

development. This is mainly due to the increase in ships' numbers, size, speed, types and the cargo they carry together with commercial demands for accurate and up-to date information. This meant that more hardware is needed to ensure that the increased risk is better mitigated to avoid maritime accidents in VTS area while facilitating trade and meeting regulatory requirements.

Today, there are VTS centres equipped with sophisticated radar systems, Automatic Identification Systems (AIS), direction finders, metrological equipment, Internet, CCTV, Infra Red Cameras, audio and image recording ability, tidal and current gauges, large display screens and equipment that allows images to be viewed at national disaster command centres or regional monitoring centres like EMSA SafeSeaNet[1]. More and more equipment is found at VTS centres, like LRIT, GMDSS, Ship Security Alert and also functions as an MRCC for SAR. This is done because of resources optimisation including human resources. However, equipment found at any VTS centre will depend on VTS type, location, available resources, expected results, traffic volume, risk of maritime accidents, responsibilities, functions and national law / regulations. VTS equipment found at Dover, Singapore, Rotterdam and other sea lanes chock points is highly sophisticated which comes with the issue of having highly trained VTSOs in order to comprehend and make informed decisions or advice to ships transiting the VTS area. Furthermore, data collected are used to improve the safety of shipping movements in any given point. Some VTS centres are tightly regulated to ensure maritime safety[2] which is always maintained at any VTS centre around the world as elaborated later within this chapter.

[1] EMSA, Sharing the European Vessel Traffic Image and Beyond. Retrieved on 20.08.2011 from WWW http://www.emsa.europa.eu/operations/maritime-surveillance/safeseanet/item/217.html?cuscat=113

[2] The definition of maritime safety was a thesis subject to ascertain the meaning as perceived by different players within the VTS domain.

2.2.3 Types and functions of VTS

IALA 2008 Manual, gives a pictorial overview in Chapter 5 as seen in Figure 1.

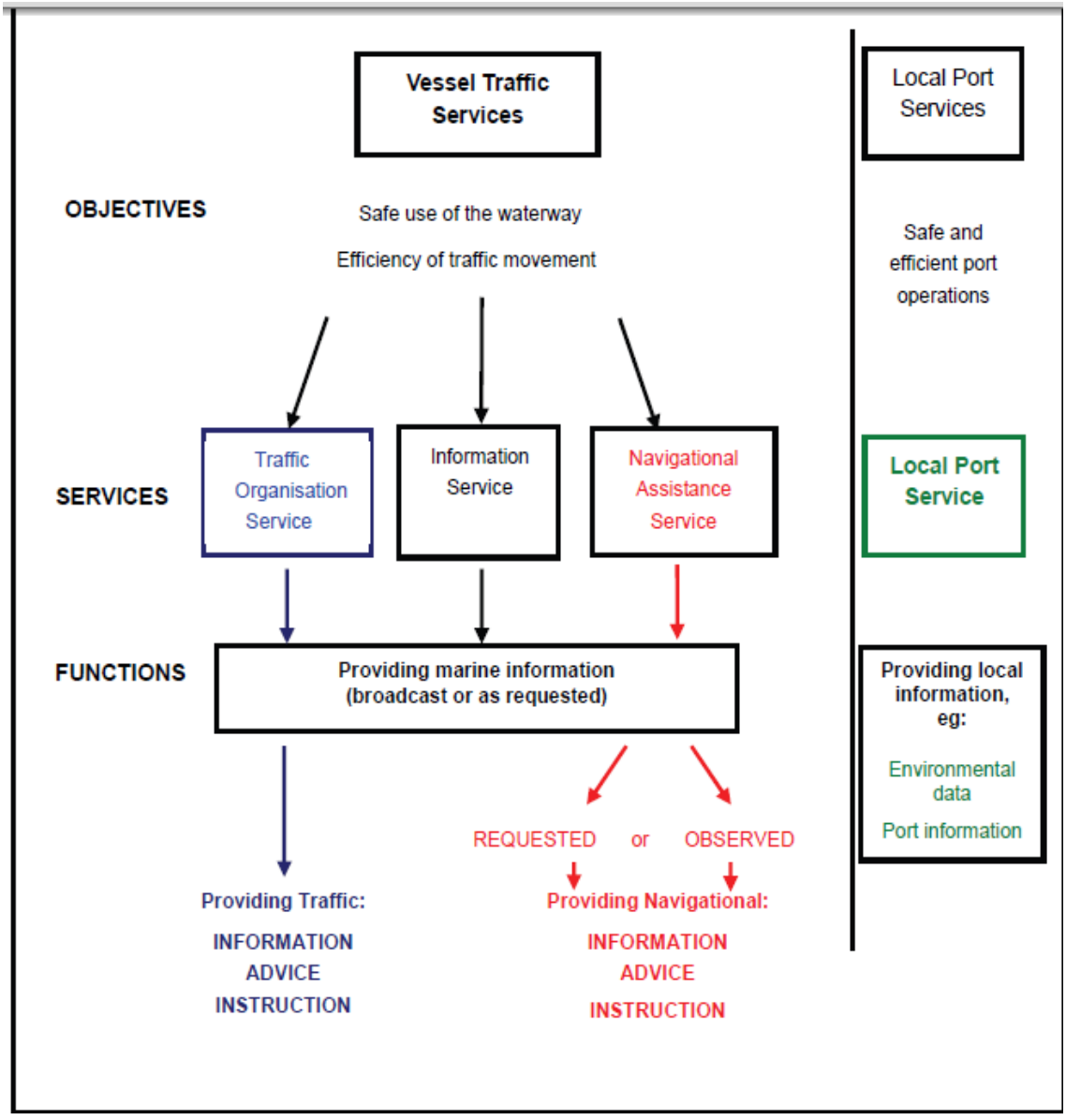

Figure 1 - Types and Function of Traffic and Port Services
Source: IALA VTS Manual 2008

As per the IALA Manual 2008, there are two types of VTS, each one having its own distinctive parameters and functions. This classification is too theoretical if compared with the present setting of VTS at some locations around the globe, yet coastal VTS fits the paradigm of a VTS as seen by IALA, especially where port activities are not present (TSS at Gulf of Suez and South of the Red Sea, Bab Al Mandeb, Tiran Strait, etc). Thus a VTS center functions as port or harbour VTS, coastal VTS or both of them simultaneously like Singapore, Dover, and small single port States. The MarNIS EU project (EU Commission, 2006) has positively identified the practical use of VTS, in which they suggested that, a VTS falls within one or more of the following 4 categories:

- Harbour and harbour approaches;
- Coastal waters and international straits;
- Offshore;
- Inland waterways.

Local Port Services "LPS" (Harbour and Harbour approaches)

LPS may be a private or public port organisation that only provides information to the bridge team and does not interact with traffic, thus it is not a VTS that is obliged by law to have the ability and /or the resources to respond to a developing traffic situation or be able to monitor shipping movements in the area. However, LPS is designed to improve port safety and co-ordination of port services by dissemination of operation information between the terminal / port and the ship. With the advancement of technology, most LPS or so called "radio rooms" are equipped with AIS display, received from a third party via the internet. This type of setting is more appropriate for a small port or in an area where the competent authority did not decide to set up a VTS area. As experience showed around the world, the LPS can create a problem for the ship as well as to the VTS centre, especially when two different orders are issued to the ship's master with regard to pilot schedule or other matters. This happens in the absence of close co-ordination and co-operation between the LPS and VTS within the same area, which is no fault of the ship's master.

Vessel Traffic Service Categories

VTS with its full elements as stipulated by the IMO guidelines and IALA standards can improve the safety of traffic and mitigate unacceptable risks, by contributing to safe navigation of ships in the area, by assisting ships to keep within navigable waters (IALA, 2008) and by providing them with up to date information regarding weather and navigational danger. The benefits of a VTS depend on its types which may be divided by the services provided and the functions performed. The distinction between the different categories of VTS is fundamental in the choice of service to be provided, its implementation, maintenance and periodic review as follows:

Information Service (INS); INS is defined by IMO VTS Guidelines as "a service to ensure that essential information becomes available in time for on-board navigational decision-making". It comprises broadcasts of information at fixed times or when deemed necessary by the VTS Authority or at the request of a vessel. The transmission may include information about ships' in the VTS area, waterway conditions, weather, navigational hazards and other factors that may influence the safe passage of vessels.

Traffic Organisation Service (TOS); TOS is concerned with the forward planning of ships' movements to prevent the development of dangerous situations in any given location, by providing essential and timely information to assist the bridge team decision making process. This service is essential in congested port approaches like Jeddah Islamic Port, Singapore Port, Port Said and others. This service is aided by pre-set clearances and defined areas on navigational charts. Instructions given as part of a Traffic Organisation Service Should be result orientated, leaving the details of the execution to the vessel (ships' masters).

The Navigational Assistance Service (NAS); This service may be provided in addition to INS and TOS. It provides essential and timely navigational information to assists the navigational decision making process on board. It may also involve navigational advice

and or instruction. The criticality of this service requires clear operational procedures from the VTS authority, which should include those who are authorized to provide this service, thus tightly regulated to eliminate any disastrous effect. The distinction between navigational information and advice implied two different approaches to the service provided. Navigational information as being a contributory task and provided either in response to a specific request from a vessel or when the VTS Authority perceives that the information would be of use to the vessel. On the other hand, navigational advice and/or instructions are regarded as participatory, in which the "VTS can become involved in the on-board decision making process by providing navigational advice. Through the exchange of information between vessel and VTS, an agreed course of action may emerge" (UK MCA, MGN 238). See p. 28 for MV. APL Sydney accident summary.

VTS Practical Evolution

Today, some major VTS centers are moving away from performing one service only as stipulated in IMO VTS Guidelines and the IALA Manual 2008. The author experienced multi tasking VTSO while on watch at a VTS center; VTSOs were performing several tasks which varied from traffic monitoring, advising, assistance, operational, commercial, security, managerial, especially in busy port approaches. This fact was also realized and documented in the 2008 IALA Manual, "Shore organizations, other than VTS authorities, at local, national and regional level need to interact with vessels. There is thus a role to be filled in the context of Vessel Traffic Management (VTM) at a level higher than the traditional roles of VTS". Tasks performed under VTM would involve having to be able to interact with AIS, SAR, LRIT, VTS, AtoN, Ships' Alert System, Pollution control (OPRC), Port Management Information System (PMIS), Co-operating with Allied Services[3], Port Operations, Emergency Services, Coast Guard, PSC, e-mails

[3] IALA VTS manual 2008, page 56 gives full details of the services to be offered.

and adjacent VTS. This shift of VTS functions has brought about some new challenges including VTSO training changes, which is regulated by the VTS competent authority.

2.3 Risks and types of maritime accidents at port approaches

The movement of ships through the water between its destinations is full of risks/hazardous in general and the level of risks fluctuates throughout its voyage. The risk of grounding and / or collision, thus environmental and property damage is greater when the ship is approaching ports, coastal navigation, busy shipping lanes or chock points like Dover, Singapore Strait, Suez Canal and others, compared to being in the open seas/oceans where ships are left to the mercy of God. Historically, it has been possible to reduce or mitigate risks at sea, coastal waters and when approaching ports. This was done by the introduction of preventive measures (IMO Conventions) and mitigating measures (VTS). Preventive measures are designed to reduce the likelihood of failures and accidents, thus control the frequency, whereas mitigating measures aim at reducing the severity of failures and accidents, thus controlling the escalation of failures and accidents when they have happened.

2.3.1 Hazards / Risks at port approaches

Hazard is an unwanted event or occurrence, a source of potential harm, or a situation with a potential for causing harm to humans (injury, damage to health), property (ship, port infrastructures "tangible"), the environment, and other things of value (tourism, state's image "intangible (economic loss)") or some combination of these. (IALA Guidelines 1018). While risk is defined as probability x impact, the term risk is also commonly used to refer to the unwanted event itself, which is defined formally as a hazard. Bannister (1997, p. 1) points out that "risk is not always loss causing and some risks cause both loss and gain" depending on who is on the benefit side after the damage has been done; for a repairer it means more business, for others it means losses as highlighted below.

2.3.2 Risk management process

IALA Risk Management Guidelines 1018, suggest techniques to be used when managing risk. The process comprises six steps that follow a standardised management or systems analysis approach: Identify risks/hazards, assess risks, specify risk control options, make a decision, take action, monitor and review. For the purpose of this research, only relevant risks / hazards identification items will be looked at in detail.

2.3.2.1 Identification of Risks/Hazards

There are five types of hazards that can generate risks in general;

- natural hazards such as floods, wind storms, earthquakes, biological hazards, and other natural phenomena;
- economic hazards such as inflation, depression, and changes in tax and fee levies;
- technical hazards such as system or equipment failure, fire, explosion, obsolescence, and air/water pollution; and
- human factors such as errors or omissions by poorly trained persons or fatigued persons, or acts of wilful negligence, sabotage or terrorism.
- operational hazards such as groundings, collisions, striking and other unwanted events. (IALA Guidelines 1018, 2005, p. 11).

Risks are unique to every individual port and area which are required to be assessed in line with national requirements for the same. Risks are mitigated using different risk control options (s) in accordance with the local acceptability risk level.

Each risk is associated with some sort of losses, ranging from health, property, economic, liability, personnel, environmental and finally reputation or status losses. Thus there is a need to achieve an acceptable balance between the costs of an incident, and the costs of implementing measures to reduce the hazards / risk of the incident happening.

Hazards / risks at port approaches are not limited to the list[4] (shown in Appendix A) that has been identified and acknowledged to have a direct or indirect effect on the outcome of events and is subjective to individual perception, level of education, resources distribution priority and line of proficiency.

[4] Hazards identified by US CG contained within; 33 C.F.R. PART 161—VESSEL TRAFFIC MANAGEMENT, Title 33 - Navigation and Navigable Waters http://law.justia.com/cfr/title33/33-2.0.1.6.29.html & 33 C.F.R. PART 160—PORTS AND WATERWAYS SAFETY—GENERAL, Title 33 - Navigation and Navigable Waters. http://law.justia.com/cfr/title33/33-2.0.1.6.28.html

2.3.3 Type of maritime accidents at ports approaches

The type of maritime accidents cannot be articulated to a specific type of accident as they keep evolving with time, grounding being one of the most frequent accidents; collisions, and allisions are other types that are common to occur at port approaches and in coastal waters. A study which was conducted in 2006 by the Department of Logistics[5], titled "Port traffic risks – A study of accidents in Hong Kong waters", showed collision being the first ranked, 54% and contact being the second, 12% among others as shown in Table 1. Knowing the locality of Hong Kong, the results shown are apparently true, but not necessary true for other areas like the Baltic Sea.

Table 1 - Average distribution of accident types in Hong Kong waters.

Average distribution of accident types

Accident types	Percentage (%)
Collision	54
Contact	12
Stranding/grounding	9
Foundering/sinking	8
Fire/explosion	7
Capsized/list	2
Machinery failure	2
Damage to equipment	1
Heavy weather damage	0.2
Structural failure	0.1
Missing vessel	0.0
Others (e.g., flooding)	4

Table 2
Location of reported accidents

	Channels (%)	Fairways (%)	Anchorages (%)	Typhoon shelters (%)	Other port facilities (%)	Open waterspaces (%)
All accidents	3	6	12	10	10	59
Collisions	3	10	20	9	10	48

Source: T.L. Yip / Transportation Research Part E 44 (2008) 921–931.

[5] A study done in 2006 which is carried out by The Hong Kong Polytechnic University, Hung Hom, Kowloon, Hong Kong.

Data related to accidents at port approaches and coastal waters involving VTS centres were requested, and raw data were received for from 2005 to 2010 (see Appendix B) from Marine Accident Investigation Branch[6] (MAIB), the UK. They were filtered more to relate it to the research; the compiled results are as shown in Figure 2.

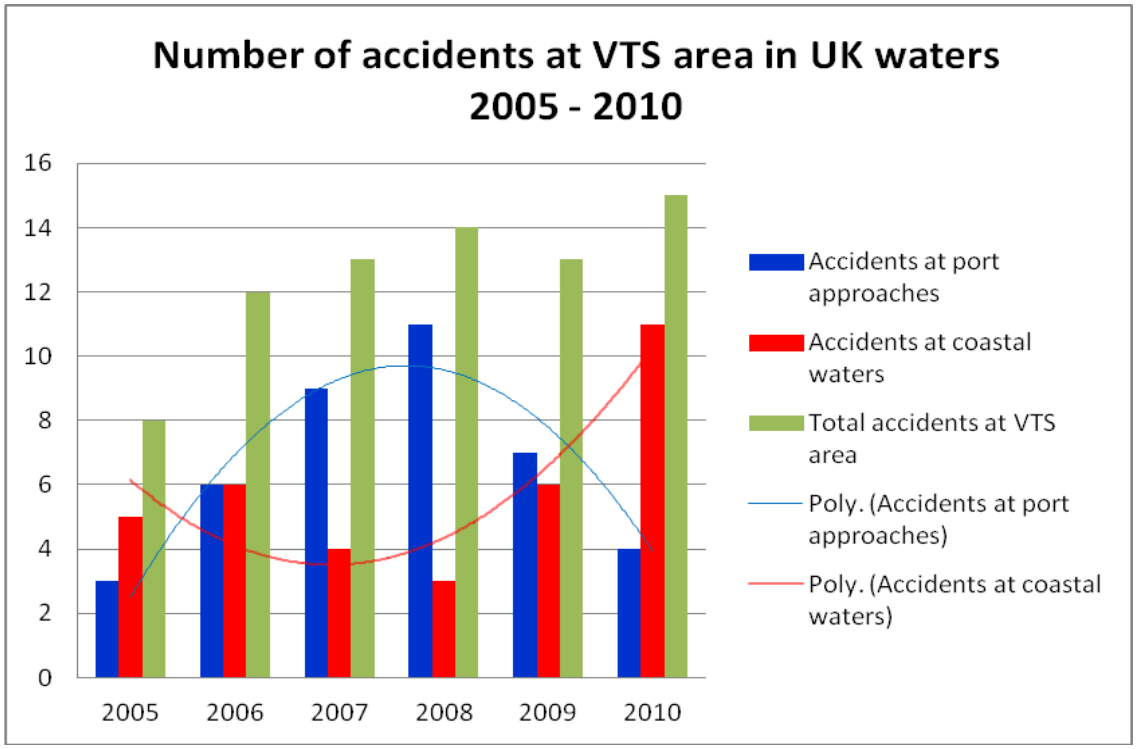

Figure 2 – Number of accidents at VTS within UK waters between 2005 to 2011
Source; Compiled by the Author from MAIB raw data, 2011.

The compiled data showed interesting trends. The number of accidents at port approaches is decreasing (may be due to the strict port authorities regulations in VTS areas) while it is on the rise at coastal waters. This is a phenomenon that needs to be researched in detail to ascertain the causal findings made by the simple MIAB data compilation.

[6] Data was requested from MAIB via e-mail regarding accidents at VTS area, raw data was given.

Table 2 shows MAIB accidents records either on board UK vessels or at UK territorial waters while "entering or leaving port" or "on Passage" 2005 – 2010.

Table 2 – VTS area accidents records in the UK

Accidents to vessels while "Entering or leaving port" or "On passage" 2005 - 2010

UK Flagged Vessels		2005	2006	2007	2008	2009	2010	Total
Merchant Vessels of 500gt or more	Entering or leaving port	41	24	21	28	29	46	189
	On passage	42	29	32	30	22	21	176
	Total	**83**	**53**	**53**	**58**	**51**	**67**	**365**
Fishing Vessels	Entering or leaving port	13	22	22	17	18	18	110
	On passage	123	118	147	89	100	109	686
	Total	**136**	**140**	**169**	**106**	**118**	**127**	**796**
Vessels in UK 12nm territorial waters								
Merchant Vessels of 500gt or more	Entering or leaving port	67	64	62	70	57	56	376
	On passage	50	37	42	38	27	27	221
	Total	**117**	**101**	**104**	**108**	**84**	**83**	**597**
Fishing Vessels	Entering or leaving port	16	25	25	17	22	21	126
	On passage	108	109	132	79	91	98	617
	Total	**124**	**134**	**157**	**96**	**113**	**119**	**743**

Prepared by MAIB for Abdulhusain Abdulla 16 August 2011

Source: MAIB data information center UK, 2011.

In summary, hazards / risks at port approaches and coastal waters are high which was confirmed by the examination of worldwide historical data on shipping accidents that identified collisions, groundings and contacts as being the most common maritime accidents taken place at port approaches and coastal waters, with varying consequences (losses), ranging from damage to health, property, economic, liability, personnel, environmental and finally reputation or status losses. Risks control options have been employed on board ships as well as around the world; they include the use of VTS, deployment and optimization of AtoN, and a better regulatory frame work on board and ashore.

2.4 Layers and elements of VTS regulations

The compelling need to harmonize maritime laws and regulations has been highlighted by Professor Mukherjee of World Maritime University (WMU) in his book (Maritime Legislation) "The inherent international character of shipping and the inconvenience and hardship generated by conflicts in practical and legal affairs make it necessary for maritime law to attain a degree of international uniformity" (Mukherjee, 2002, p. 113). The same is true with harmonizing maritime safety regulations which was reflected in the preamble of the IMO VTS Guidelines, "RECOGNIZING ALSO that the use of differing vessel traffic service procedures may cause confusion to masters of vessels moving from one vessel traffic service area to another" (IMO resolution A.857(20)).

The inception of VTS (as one of several risk control measures to promote maritime safety) around the world sprung out of States' obligations as setup in the UNCLOS 82. The following literature will shed light on the relationship between the United Nation Convention on The Law Of The Sea 1982 (UNCLOS) and the VTS, IMO obligations as setup in UNCLOS, IMO conventions and the VTS, IMO Guidelines for VTS, IALA contribution to the VTS, VTS National Legislation (see Figure 3).

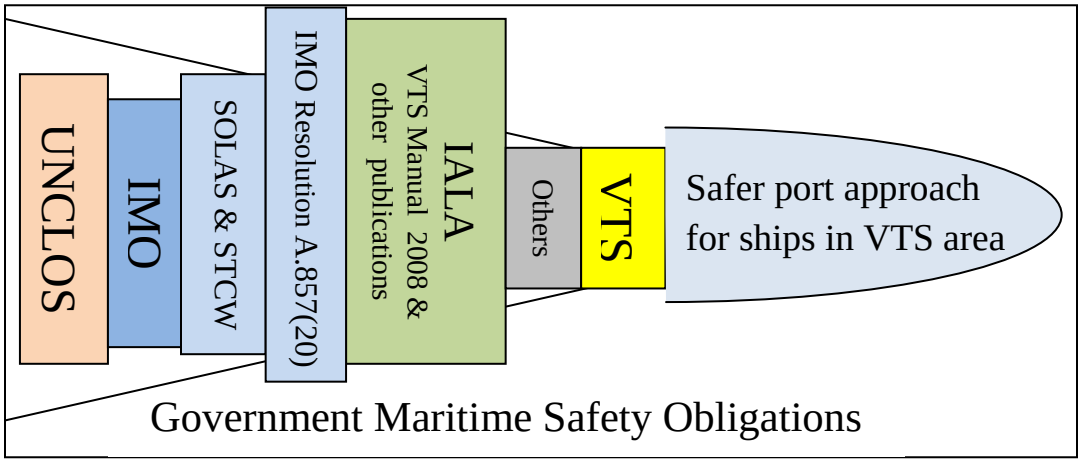

Figure 3 – International Conventions and Instruments used to regulate VTS
Source: Author 2011

2.4.1 The International Framework

The international VTS framework is about those conventions that are regarded as public instruments, which set out the various requirements and expectations as follows:

2.4.1.1 UNCLOS and the VTS

UNCLOS 1982, brought about the results of several years of negotiations between States in coordination with the maritime community around the world. States have also came together at different UN forum to:

> develop a coherent, consistent, and efficient approach to VTSs sourced in international law and internationally agreed upon guidance documents. Any examination of the international framework for vessel traffic management must begin with the 1982 U.N. Convention on the Law of the Sea (UNCLOS). The Convention is widely viewed as a constitutive instrument which provides a basic legal framework that was designed to be complemented by additional international agreements, most of which are developed through the IMO (Allen, 2009, pp. 10-11).

Article 24 (2), of the Convention imposes a limited duty on coastal states to provide information services to vessels in their territorial sea. However, the Convention limits the applicability of coastal state vessel traffic management measures in the state‘s territorial sea or exclusive economic zone, e.g. jurisdiction over foreign vessels in innocent passage through the state‘s territorial sea or in transit passage through an international strait. Article 21 of UNCLOS, permits a coastal state to adopt laws and regulations relating to foreign vessels on innocent passage through the territorial sea where, inter alia, such laws respect the safety of navigation and the regulation of maritime traffic. The convention requires the States to adopt measures through the “competent international organization” (IMO), that may minimize the threat of accidents which might cause environmental pollution, UNCLOS Part VII.

2.4.1.2 IMO Conventions and the VTS

IMO has been given the mandate to further regulate the provisions of maritime safety and marine environment protection as stipulated in its generality within UNCLOS. The two main IMO conventions governing the VTS issues are the International Convention on the Safety of Life at Sea (SOLAS) and the Convention on Standards of Training, Certification and Watch-keeping of Seafarers (STCW), in which they regulate VTS establishment, organisation, conduct of VTS operations, and the training and certification of VTS personnel as well as those on board ships.

SOLAS 74

IMO Maritime Safety Committee (MSC), adopted a new regulation (12) in June 1997 which establishes conditions for implanting VTS. This was revised in 2000 and entered into force in July 2002. (IALA VTS Manual 2008). SOLAS Chapter V which addresses operational safety of navigation acknowledged that "marine risk management efforts must extend beyond vessel CDEM[7] measures" (Allen, 2009, p.13).

Within SOLAS Chapter V, Regulation 12 "Vessel Traffic Services"[8], the regulation makes reference to the IMO adopted assembly resolution A.857(20) of 1997 regarding Guidelines for VTS, which is not mandatory to member States. The IMO VTS Guidelines are designed to be implemented in conjunction with other IMO Criteria for Ship Reporting Systems, resolution MSC.43(64) as amended and the IALA VTS Manual.

[7] Construction, Design, Equipment, and Manning (CDEM), acronym used in Allen, 2009, Article. .
[8] Full text of the regulation can be found in IMO SOLAS Convention, consolidated edition 2009 on page 251.

STCW 78 as amended, Convention and Code

The Convention establishes international standards for mariners competencies, qualifications and training. The STCW Convention imposes obligations on the shipowner or operator, the ship‘s master, and watch officers. “STCW prescribes internal risk management measures that must be considered in any examination of existing or proposed external risk management measures, such as VTS” (Allen, 2009, p.16). Since its adoption in 1978, the Convention has undergone two major revisions in 1995 and most recent in 2010[9]. The recent amendments require deck officers to learn the use of ship reporting (including VTS procedures) to maintain a safe navigational watch[10]. The use of the Standard Marine Communication Phrases (SMCP) is also a part of ship’s officer curriculum which is the same for VTSO. In addition, requirements for voyage planning are incorporated into both the SOLAS and STCW Conventions.

[9] STCW, Manila Amendments, June 2010.
[10] STCW Code- Table A-II/1. Full text can be found at page 101 of the STCW Convention which include Manila amendments , 2011.

2.4.1.3 IMO Guidelines for VTS (Resolution A.857(20) 1997

Since IMO recognition of the VTS value in 1968, several resolutions have been issued as listed below;

- Resolution A.158 (ES.IV) Recommendation on Port Advisory Systems, adopted 1968.
- Resolution A.578 (14) Guidelines for Vessel Traffic Services, adopted 1985.
- Assembly resolution A.857(20) Revised Guidelines for Vessel Traffic Service, adopted in November 1997.

SOLAS Chapter V Regulation 12/3, requires contracting States where possible to follow the Guidelines for Vessel Traffic Services developed by the Organization and issued via IMO Resolution A.857(20) adopted by the IMO on 27 November 1997. The guidelines contain two annexes covering a spectrum of issues that are relevant to establishment, regulating as well as the operational issues (running) of the VTS as explained below.

Annex I, contains general definitions, administrative and legal elements that a contracting government should consider when setting up a VTS. There are at least two major definitions which are of importance in regulating any VTS.

"Competent authority; is the authority made responsible, in whole or in part, by the government for safety, including environmental safety, and efficiency of vessel traffic and the protection of the environment". Its role is vital during the planning and establishing of the VTS, in which it should ensure, inter alia, the presence of a legal basis for the operation of a VTS and is operated in accordance with national and international law, that a VTS authority is appointed and legally empowered, objectives for the VTS are set, service area is delineated and declared as VTS area, the VTS centre is properly manned by qualified and trained staff and the VTS is operated in accordance with relevant IMO resolutions. Furthermore, the VTS authority should establish appropriate qualifications and training requirements for VTS operators, determine the type and level of services to be provided, establish appropriate standards for shore and offshore based equipment, finally establish a policy with respect to violations of VTS regulatory requirements.

"VTS authority - the authority with responsibility for the management, operation and coordination of the VTS, interaction with participating vessels and the safe and effective provision of the service". In summary, the VTS is the executive arm of the competent authority and is required to ensure that objectives of the VTS are met, ensure that the VTS operations are harmonized with ship reporting and routeing measures, aids to navigation, pilotage and port operations.

In addition, it should adhere to the set standards, requirements and level of services of a VTS, make sure that operating procedures for routine and emergency situations are established, information regarding the availability of VTS is published in the appropriate nautical publications and in the "World VTS Guide".

Finally, it should consider the legal implications of shipping accidents where the VTSO may have failed to carry out their duty competently.

Other items of concern to this research are as follows:

Operating procedures, which require distinction between internal and external procedures, where "Internal procedures cover operating instruments, interactions among the staff and the internal routing and distribution of data. External procedures cover interactions with users and allied services" (IMO Resolution A.857(20))

Guidance for planning a vessel traffic service includes a list of hazardous items that necessitate the use of a VTS, which include, inter alia areas of high traffic density, ships carrying hazardous cargo, conflicting and complex navigation patterns, difficult hydrographical, hydrological and meteorological elements, shifting shoals and other local hazards, environmental considerations, narrow channels and port configuration.

Annex II, provides a framework that elaborates specifically on how and what standards the VTS authority can use to fulfil its obligation with regard to human elements that operate the VTS centre as stipulated in the same guidelines (Annex I, 2.2.8). The guidance is complemented by various IALA recommendations regarding training of VTS personnel (as shown in Appendix C).

2.4.1.4 IALA contribution to the VTS

The International Association of Marine Aids to Navigation and Lighthouse Authorities (IALA) is a non-profit making international technical association, established in 1957. It has approximately 75 national members and 30 affiliated organizations. IALA is a Non-Governmental Organisation (NGO) and has a permanent chair at the IMO meetings and it brings together services and organizations concerned with the provision or maintenance of marine aids to navigation systems and allied activities at sea and on some inland waterways, which are navigable by ocean-going vessels. In this context, VTS is considered to be an aid to navigation. The IALA consultative body for VTS matters constitute highly professional bodies like:

International Maritime Pilots' Association (IMPA),

International Harbour Masters Association (IHMA)

International Federation of Shipmasters' Associations (IFSMA)

International Association of Ports and Harbours (IAPH) and

The Nautical Institute

IALA has been involved in the drafting of all IMO guidelines concerning VTS since 1985. It was decided that Resolution A.857(20) remains unchanged and IALA will publish up-to-date information as required and where appropriate in the VTS Manual (IALA VTS manual, 2008, p. 45). In 2000, IMO recognized the development of the IALA recommendations and other documents and invited its member States to bring those recommendations to the attention of their VTS authorities. Subsequently, the IALA standards are now generally recognized as the primary training and certification standards for VTS personnel. The IALA VTS Manual 2008, chapter 8, suggests that in planning a VTS, the powers and authority delegated to individual VTS operators will need to be established by the VTS Authority; it highlights the need for VTS personnel to be aware of the legal basis under which they are operating and from which they derive the authority to interact with traffic. It also highlights issues that need to be legally

addressed regarding lines of responsibilities as well as actions to be taken against infringement of VTS regulations, power of enforcement and most importantly VTS and operator liability (See appendix C).

2.4.2 National Legislation for VTS

Contracting governments party to UNCLOS, SOLAS and STCW are obliged to enact appropriate national legislation to give effect to the provisions that have been agreed. Such enactments will, where appropriate, include provisions for enforcement and sanctions for infringements. Governments may chose the appropriate way to incorporate the same into the national legislation. For practical reasons, most governments have relied on two main bodies of primary legislation: Merchant Shipping Laws or Acts and Harbour or Port, or Docks Laws or Acts. SOLAS and other IMO Convections involve items that also extend to the maritime public which is "effectuated through national regulatory legislation incorporating the relevant international regulatory convention" (Mukherjee, 2002, p. 55). In his book, he suggested a scheme of maritime legislation which incorporated a chapter on "Ports Administration and Pilotage"; the regulatory framework for a VTS was not addressed explicitly to emphasise its specialty in mitigating maritime accidents, but SOLAS gave the right to the State to make VTS mandatory as appropriate, thus to avoid a legal vacuum, the author's view is to of incorporate it within the Port Act.

Generally, harbour acts would be of a national character with uniformity in the application of laws to all port undertakings, so it would be followed by local legislation which is area specific. Other by-law requirements have not been a requirement (or not seen to exist) in some States. Its absence shows its importance in which it is also regulated at national level in some countries (e.g. USA).

There is no one ideal VTS national legislation as seen from the literature; however, most States who have VTS regulations are meeting the IMO VTS Guidelines and IALA

recommendations. Yet there are some who are exceeding the IMO Guidelines while others are having their own regulations which do not conform with international standard and expectations. This is reflected in the IMO Guidelines for VTS "RECOGNIZING ALSO that the use of differing vessel traffic service procedures may cause confusion to masters of vessels moving from one vessel traffic service area to another"; this is further highlighted in the use of US VTS terminology in which "direction" (using U.S. terminology) means "instruction" as per the IMO SMCP terminology[11].

State legislations are expected to conform with the minimum requirements as set in the IMO Guidelines for VTS and IALA recommendations. The name of the act will vary around the world depending on the need to explicitly have a separate act like in the Netherlands "National Shipping Traffic Act of 1988"; in the US it is "Port and Waterway Safety Act (PWSA) of 1972, as amended". The degree of information has been broken down into 4 main elements, namely Primary Legislation, Secondary Legislation/Statuary Instruments, Guidance at national level and finally Byelaws (see Appendix D). The World Bank Port Reform Toolkit augments in the "Port-tool-kit"[12] document, the need for the competent authority to regulate the VTS, if it is to be included in the concession agreement.

IALA Guidelines No. 1055 on preparing for a Voluntary IMO Audit on Vessel Traffic Services Delivery, gives guidance to its members on those sections of the pre-audit questionnaire that the administrations in charge of Vessel Traffic Services (VTS) have to answer according to their obligations in SOLAS regulations V/12.

[11] IMO, Resolution A.918(22) Standard Marine Communication Phrases (SMCP).
[12] See World Bank Port Reform Toolkit for elements. Retrieved on Aug 15 2011 from; http://www.ppiaf.org/ppiaf/sites/ppiaf.org/files/documents/toolkits/Portoolkit/Toolkit/module3/marine_services.html

2.5 The VTS contribution in maritime accidents as seen in the court

In some circumstances, there will be some claim cases which are referred to the court following accidents. Regulating VTS area may have reduced the number of accidents in the VTS area, yet accidents still take place because of many reasons. Two accidents involving VTS are overviewed below.

2.5.1 The Port of Melbourne v M.V. APL Sydney ship's owner

On 13th December 2008, the APL Sydney dragged its anchor across a submarine gas pipeline in Port Phillip Bay (Melbourne – Australia) within the VTS area, allegedly causing extremely large losses to the Ethanol pipe line[13]. Following the accident, an independent investigation was carried out by Australian Transport Safety Bureau (ATSB); the investigation[14] identified safety issues in relation to:

- The port's risk management with respect to the pipeline and anchorage boundaries and its shipping control procedures; the ship's safety management system; the pilotage company's safety management system.
- *APL Sydney*'s safety management system did not adequately ensure that the master was certain about his overriding authority and responsibility with respect to decisions and actions aimed at ensuring the safety of the ship. *[Significant safety issue]*. p. 62.
- The Port of Melbourne Corporation's shipping control safe operating procedures, the port operations handbook and shipping control staff training did not provide the control officer with adequate guidance and information to allow him to safely manage the events of 13 December 2008 and give appropriate instructions, advice and information to the *APL Sydney*'s master and pilot. *[Significant safety issue]. p. 62.*

[13] Maritime Accident Casebook, 2010. APL Sydney Gas Pipeline Rupture – Comms The Snag. Retrieved on 15.08.2011 from http://maritimeaccident.org/2010/04/apl-sydney-gas-pipeline-rupture-comms-the-snag/

[14] ATSB, Marine Occurrence Investigation No. 260, MO-2008—012. APL Sydney Accident report. Retrieved on 14.08.2011 from http://www.atsb.gov.au/media/1373626/mo2008012.pdf

In view of the findings, ATSB issued "Safety Action" to be undertaken by the all parties, including the VTS authority. In addition to revising the anchorage area, a new requirement for masters and pilots to report their intended anchorage position to VTS, this is to enable improved traffic monitoring and control by VTS officers via the VTS electronic displays. Other measures taken include requirement to switch to comprehensive dynamic risk assessment if wind exceed 30 knots in inner port, new procedures to confirm strong wind warnings are received on board anchored ships, risk control measures to be considered by the VTS authority which "include a review of VTS operator training for monitoring anchored ships so that an early warning can be given to any ship that do not maintain position. The introduction of standard procedures for anchoring ships in heavy weather is also to be considered and agreed with PPSP[15]". (ATSB, 2008, p. 52).

The same accident claim[16] was brought before the court, in which among other interesting aspects of the decision made by judge Rares relating to the roles of the Port Authority. He said "It is disturbing that the port authority, through harbour control" objected on the pilot's suggestion, apparently had no emergency plans for the contingency that was unfolding; the harbour control radio operators should have been trained to meet such a contingency including the danger associated with the use of any source of fire with fouled gas pipe lines. This reflected the role of VTS in mitigating maritime risk through regulating the VTS actions which include, holistic risk assessment accordingly.

[15] Port Phillip Sea Pilots (PPSP)
[16] Casenote, 2010. Strong Wise Limited v Esso Australia Resources Pty Ltd [2010] FCA 240. Retrieved 14.08.2011 from http://www.cbp.com.au/getattachment/3948a5c3-a25a-4ca7-8894-3bc8ee5510e1/Strong-Wise-Limited-v-Esso-Australia-Resources-Pty

2.5.2 Collision at National Port Authority (NPA) VTS area - South Africa.

Two ships collided at the approach to Cape Town in the vicinity of the TSS which is the same as the VTS area. The visibility was less than one nautical mile and one ship was steaming in the wrong lane after departing the port; in the mean time the VTSO did nothing to alert the two ships. The two ship-owners plus others after settling their differences

> agreed to pool their claims against the Port Authority and to institute action against the Port Authority for their damages arising from the collision. In essence, the basis of their claim was that the Port Authority was liable for the damages sustained by them due to the negligence of the VTSO, who failed to provide any information, recommendations, warnings or directions to either of the vessels prior to the collision, as a result of which the collision occurred. At the trial it was admitted that the crew of both vessels were causally negligent, but it was argued that the Port Authority was also partially to blame and thus should bear some of the loss. Midway through the trial the matter settled. The principal claim against the Port Authority by the owners of the two vessels and the cargo interests was in delict4 (i.e., tort, in English terminology). In most claims against a VTS Authority the plaintiff will inevitably base the action in tort, although it is conceivable that in certain circumstances a contractual claim may arise[17] (MacWilliam and Cooke, 2006, p. 366).

The South African courts have made it very clear to any public authorities including NPA, that it hold public authorities liable for their negligence in appropriate cases including the act of the VTSO. Furthermore, it is highlighted that if the loss of a VTS customer is due to the negligence of VTS authority, it should be held liable accordingly.

[17] MacWilliam, R. and Cooke, D. [2006] L.M.C.L.Q 362. VTS: Lifting the fog of legal liability. Retrieved Aug 10th 2011from WWW: http://www.i-law.com/ilaw/doc/view.htm?id=130505

2.6 Summary.

VTS is a term adopted at the IMO to describe a range of systems put together and used by port and coastal States to enhance maritime safety, protection of the marine environment and lately security. Type and function is decided by the competent authority of the State, depending on the outcome of the risk assessment undertaken to determine the risk control measures (options) required to mitigate the risk identified at the coastal or port approaches.

VTS is regulated at different levels, where it is States' obligation as per UNCLOS and further amplified by IMO through SOLAS and VTS Guidelines in conjunction with IALA VTS regulating instruments.

IMO encourage its member States to follow its guidelines to ensure global VTS procedures harmonization. A State may have further requirements that conform with its national laws and regulations. The liability of a VTS authority for an accidents inside the VTS declared area will depend on the States' national liability laws and may vary around the world.

CHAPTER 3 METHODOLOGY

3.1 Introduction.

This chapter describes the research design and method which will be utilised to complete this research. The layout of the chapter is as illustrated in Figure 4. The chapter starts with a full description of the qualitative research design which will be used in the context of this study. The later part of the chapter describes the selection of the population, sources of data collection, and the used techniques for data analysis.

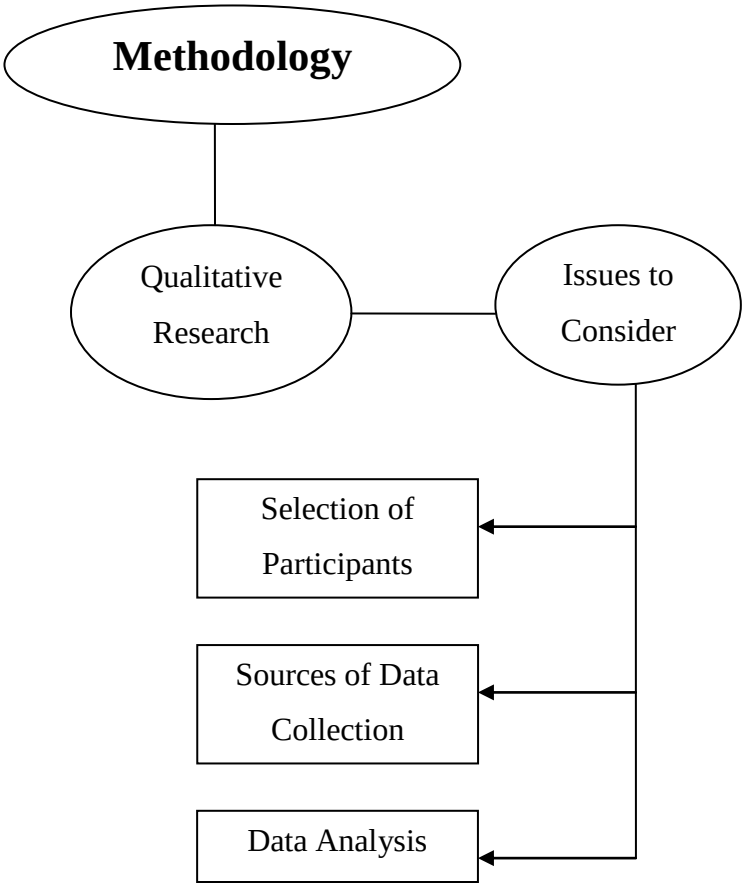

Figure 4 - Summary of research methodology
Source: Author. 2011

3.2 Research design

The research aims to understand and explore the current regulations and information regarding VTS including benchmarks, to better mitigate maritime accidents at port approaches in quest of maritime safety. Thus the research will be based on the qualitative research methodology. According to (Zikmund, 2000) the focus of qualitative research is not on numbers but on words and observations, stories, visual portrayals, meaningful characterisation, interpretations, and other expressive descriptions.

The study can be characterised as explanatory research. (Saunders, M., Lewis, P. and Thornhill, A. , 2000), and other writers define explanatory studies as those which try to establish casual relationship between variables (regulating VTS to mitigate maritime risks). The study emphasis is on the use of regulations as a risk control measure .

3.3 Research Methods

Given the nature of the research which is explanatory, a qualitative research design will be used and is well suited to answer the research questions. It involves collecting data by observing, asking questions, dialogues with individuals and examining documents and case studies. It also ranges from being highly structured to very unstructured at the point of data collection. Qualitative research will give the depth of information required to study the case, and will provide an insight into the use of regulations to mitigate maritime accidents at port approaches. Qualitative data analysis can be helpful to focus on the process and on the overall understanding of the respondent. A short questionnaire was used to explore the current setting / understanding and perceptions of VTS centres. While semi structured interviews, observations and self experience (as a VTS operator as well as regulator) were used to complement the results derived from the questionnaires and the secondary data collected.

3.4 Selection of participants

The participants were selected on the basis of having up-to date VTS centre(s) and complemented with apparently robust regulatory system, others were chosen because it was easy to access to them via e-mail (see Table 3 for details). However, other participants were chosen because of their links to the business of VTS or having a major port in developing countries. The participants also involved ships' masters and maritime casualty investigation authorities. The fact that the interviews and questionnaires were done during the month of July, which is the summer holiday for most regions did not affect the outcome of participation either in numbers or in quality.

Table 3 - List of Participants

No.	Establishment	Remarks
1	MAIB	Records of VTS related accidents at port approaches in the UK.
2	UKHO	Publication of VTS on ALRS.
3	Gdynia VTS	Field visit to Gdansk VTS
4	Malmo VTS	Interview with VTS manager.
5	Maritime Administration in developing maritime States	Respond to questionnaire
6	Ships' Master and officers	Respond to questionnaire
7	Institutions	Research documents on VTS
	others	Interview with VTS expert.

Source: Author, 2011

3.5 Sources of data collections.

One of the most important aims of this research was to collect available regulatory data from developed and developing nations related to VTS regulations. Furthermore, the author intended to find and analyze information contained within international agencies/bodies like IMO, IALA, IAPH, IMPA and VTS makers. The information was used to develop a comprehensive understanding of VTS regulations around the world and IMO requirements. Yet this research is constrained by the available time frame to finish it. Some prospective VTS respondents are far away from the study area; therefore, e-mail was deemed to be the quickest and most economical method to disseminate questionnaires. World Maritime University field study trips were also utilized to establish contacts and do casual interviews with VTS centres where visited.

During data collection, four methods were used to collect data: literature study, court case proceedings, questionnaires, interviews and observations. Primary data were collected from maritime law text books, scholarly articles, case digests, specialized text books, conventions and guidelines and States' maritime law, while secondary information was obtained from related journals, industry periodicals unpublished materials, dissertations, case summaries, seminar papers, field study interviews.

The internet was used extensively to search and view both secondary and primary information as the e-era has moved information closer and faster than before. Moreover, the use of computers today allows information to be stored and analysis can be done in different format and methods.

By doing this, theoretical information was obtained which reflected the current regulations and perception of the industry and the IMO member States, which enabled the researcher to narrow the regulations gap for a better understanding of mitigating maritime accidents at port approaches.

VTS centres, court cases involving VTS issues and casualty investigation bodies were the main source of data collected. Again this gave the research the reliability and validity it seeks to maintain. However, the data are more "raw" and are seldom pre-categorized; consequently, there was a need to re-organize all of that raw details.

In order to collect the data from some of the above sources, in-depth semi-structured short interviews were carried out, which was the most appropriate method because of the time available. People tend to pay little if no attention towards other means of data collection (subjective to world region, and national settings), and because the research is an academic requirement more than an organisation request/project (like the EU projects "MarNIS, Baltic Sea-master I and II, etc"). The questionnaires stand a little chance of respond on time unless they are based on influences or network in which the feedback can be biased. However, a questionnaire was used to have the opinion and understanding / expectations of the respondents to the research questions.

Carrying out the interviews and disseminating questionnaires with the full relevant population helped in developing a wider network around the world. Finally, interviews will allow flexibility with the participants; however, an un-structured interview is better because it allows the interviewee to express all his perceptions with no leads what so ever. But interviews take much time, are hard to analyse and compare unless they are structured. Further, they can be costly (especially when using telephone and having to travel). For the purpose of analysis and record keeping, interviews have been recorded for later use and safe keeping for those participants who agreed to be recorded.

Other methods of data collection were the use of internet on a selective basis from different parts of the world which aided the analysis process when confirming validity and looking at VTS regulations around the world. Some ports and VTS centres have their data on line as required by their national law and to create a competitive and transparency edge they seek in marketing the port.

The data collection was done in three phases using different data collection instruments in each phase as explained in Figure 5.

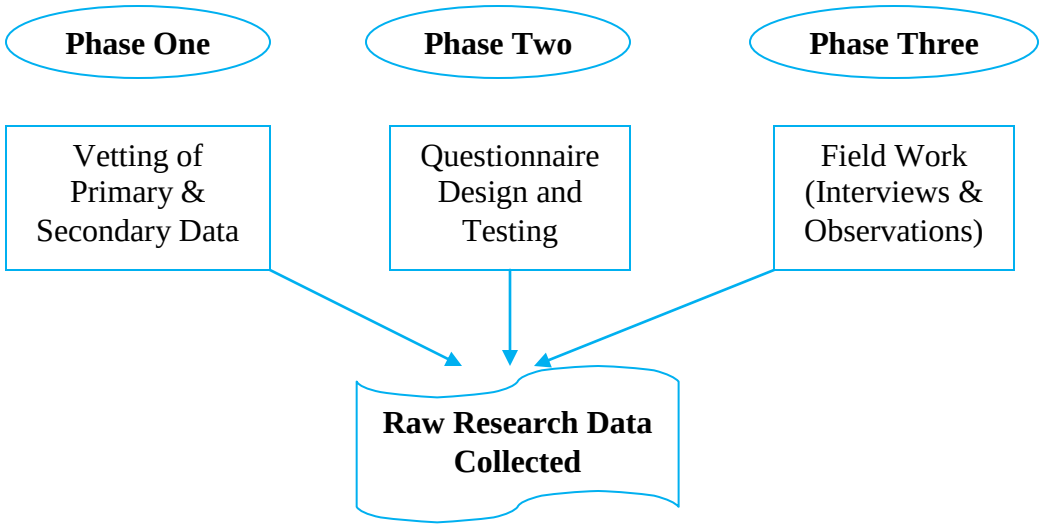

Figure 5 - Phases of Data Collection

Source; Author, 2011

Phase One

Screening of Primary & Secondary Data (documented data)

Reviewing such data before carrying out the interviews gave the researcher a provisional direction which is built on the current industry norms and standards among developed nations. It helped in preparing for general direction of the interview (see Appendix H) to obtain up-to date information and not ask for information which is already documented; subsequently, this reduced the interview time and made it more constructive. However, in the absence of proper data mining coupled with the need to exactly know what is been looked for and the quest to learn more about VTS operations around the world, all of this was time consuming and frustrating at times.

Phase Two

Questionnaire Design and Testing

Questionnaires were prepared for the participants (shipboard officers & VTS centres, competent authorities); the same was tested in comparison to other literature questionnaires **(**IALA Guideline No. 1055 on preparing for a Voluntary IMO Audit on VTS delivery**)** and feedback from mariners before being e-mailed to the VTS community (see appendices E and F). The questionnaires were introduced via the same e-mail sent to participants explaining the purpose of the study and its benefits (see appendix G). For expeditious responses, the researcher had to send a reminder e-mail before the suggested dead line. However, this proved to be more difficult than anticipated, as the feedback took longer than usual. In some instances it was decided to drop the responses at a set date in order to complete the analysis on time.

Phase Three

Actual Interviews and Observations.

This phase involved face to face interviews using semi-structured interview style, in which a set of relevant questions were prepared beforehand in order to reduce the interview time, (see Appendix H). A tape recorder was used to record the interviews for later usage during the analysis process. Each interview lasted about 30 to 60 minutes and was only recorded with the consent of the interviewees. The transcripts were later edited for accuracy and summarized for better data presentation.

3.6 Data Analysis

Saunders, et al, (2000), point out that because of the features of the qualitative data, there is no standardised approach to the analysis of the data. In order to analyse the data collected, Miles and Huberman's (1994) interaction model was used to analyse the data. It involves data reduction, data display and drawing valid conclusions.

Data Reduction

The mass of data has to be organized and somehow meaningfully reduced or reconfigured**.** Miles and Huberman (1994) define it as "The process of selecting, focusing, simplifying, abstracting, and transforming the data that appear in written up field notes or transcriptions." Not only do the data need to be condensed for the sake of manageability, they also have to be transformed, so they can be made intelligible in terms of the issues being addressed. Data reduction often forces choices about which aspects of the assembled data should be emphasized, minimized, or set aside completely for the purposes of the project at hand.

Data Display

This is the second element or stage in Miles and Huberman's (1994) model of qualitative data analysis. It provides "an organized, compressed assembly of information that permits conclusion drawing...". Data displays, whether in word or diagrammatic form, allow the analyst to extrapolate from the data enough to begin to separate systematic patterns and inter-relationships. At the display stage, additional, higher order categories or themes may emerge from the data that go beyond those first discovered during the initial process of data reduction.

Conclusion Drawing and Verification

Conclusion drawing involves stepping back to consider what the analyzed data mean and to assess their implications for the questions at hand. "The meanings emerging from the data have to be tested for their plausibility, their sturdiness, their "conformability" - that is, their validity" (Miles and Huberman, 1994). However, qualitative data may be analysed using other alternative approaches (e.g. narratives and meaning, software) but for the time being, the focus is on the above with the triangulation method in mind. The data were divided during the analysis into three categories, mainly VTS authority/centres perception, ship's master expectations and court case rulings. The population for this research comprised selected regulators, VTS centres around the world and VTS user (ships' Masters) from different shipping companies.

3.7 Summary

Qualitative research methodology was used because of the explanatory and inductive nature of the study. Data were collected from primary sources involving the use of court case, literature review, World Maritime University (WMU) field study trips, questionnaires which were designed to be general in order to ensure confidentiality of participants. Further, face to face semi structured interviews were carried out to allow the participants space in order to express themselves freely. Other sources of data gathering involved the examination of secondary data obtained from either internet or VTS related web sites, peer reviewed journals, conference/ seminar proceedings, research reports, periodicals and lectures handouts. Careful data filtering was made to the selected data for their relevance to the topic. Finally, data analysis depended on interpretation for categorization and data display to draw conclusions on regulating VTS to mitigate maritime accidents at port approaches.

CHAPTER 4 RESULTS OF THE QUESTIONNAIRE

4.1 Introduction

This chapter presents the results of the questionnaires and the information found within the collected from the literature, survey questionnaires, , vetted secondary data, and seminars conducted at World Maritime University during the study period especially "Maritime Law and Policy, VTS & pilotage" and also from the researcher's experience and observations while working in the same field. Changing hats between a "VTS operator, users (master and pilot)" and now regulator helped the researcher to understand the perspective of the actors involved in the VTS shipping domain. International actors, mainly the IMO, IALA, MCA, USCG, MAIB, UK HO and EMSA literature study were conducted. Various guidelines and recommendations concerning VTS regulating issues were studied, using static information displayed on the actors' homepages or responses via e-mail. Documents pertaining to VTS regulations, accidents' records at port approaches and court cases involving VTS were also studied. The study was organized to explain how a VTS avail maritime authority can be regulated in controlling the number of accidents at port approaches.

Participants overview

Invitations were sent to shipping companies to disseminate the questionnaires to shipboard officers, and a total of twenty two (22) questionnaires were received from seafarers comprising masters, chief, second and third officers serving on different types of ships. They represent a simple random sample (Weiss, 2008, p.12) (see Appendix I). Fourteen (14) VTS centres / competent authorities also participated from five regions as shown in Appendix J. Finally, four (4) interviews were conducted mainly in the EU region. Furthermore, other sources of data gathering mechanisms were used to answer the three research questions.

4.2 Study findings

This section reports the major findings of the study with particular attention to the data as collected from the questionnaires that addresses the research questions. It is divided into three sub-section as follows:

Research Questions:

1. *What are the risks that need to be mitigated in areas of port approaches?*
2. *How can VTS (operators) be involved in accident development and what is their liability?*
3. *Are there KPI or benchmarks for VTS to be regarded as good for mitigating maritime accidents?*

In analysing the data collected, the study used Miles and Huberman's (1994) interaction model in order to explore the participants' insight regarding the research questions, mainly risks at port approaches, accountability of VTSO as regulated and benchmarks of VTS centres. It involves data reduction, data display and drawing valid conclusions. Data were coded, summarized and clustered into categories using a matrix approach for each research question. Microsoft Excel sheets were used as alternative forms of data display. The next paragraphs shows the results of the research survey questionnaires. Figure 6 and 7 illustrate the distribution of the research population.

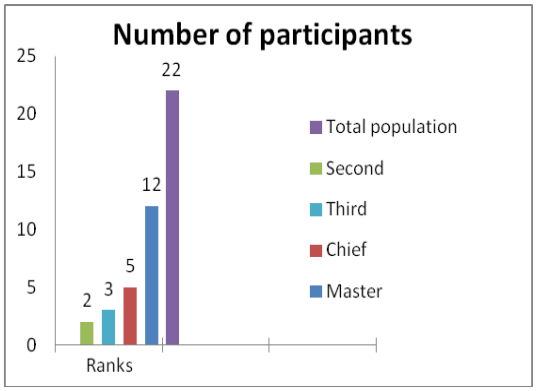

Figure 7 - Research participants.
Source; Author, 2011

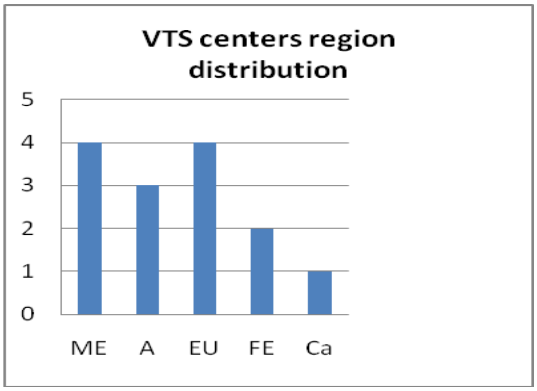

Figure 6 - VTS distribution.
Source; Author, 2011

4.2.1 Research Question 1

What are the risks that need to be mitigated in areas of port approaches?

Identifying elements of risk in its general term that may be used around the world proved to be a more difficult task than anticipated; however, there are certain elements that are inherited within any given industry. The concept of listing risks to be mitigated at port approaches was focused on the practical experiences of ships' officers as well as VTSO and port approach accident reviews.

In investigating what are the risks at port approaches, and feedback to questionnaires were sorted out for an in-depth analysis. Drawing on the data sorted and analyzed, four main additional hazards factors were identified namely: ship's staff area experience, VTSO ship's awareness and expectations, local shipping traffic density and finally busy VHF working channels.

Table 4 shows the number of respondents in agreement with the suggested risks associated with port approaches.

Table 4 - Additional risk factors to consider at VTS area.

R. Qstn	Item	No. of participants				Sum
	Total Population	12	5	2	3	
	Ranks on board	Master	Chief	Second	Third	22
Q 1	Local Shipping traffic density	10	5	1	3	19
	Master / officer area experience	10	4	2	3	19
	Busy VHF Communication channel	9	4	0	3	16
	VTSO ship's awareness /expectations	9	3	1	3	16
	VTSO English ability	8	3	1	1	13
	Ship's staff VTS awareness /expectation	6	3	1	3	13
	Lack of VTS area Info.	5	3	0	1	9

Source: Author, 2011

So what sort of facts did the risk questionnaires elicit?

The participants (22 ships' officers), collectively gave different weight to each suggested factor to be considered when addressing the risk identification at port approaches. These are in addition to those risks that are location dependent. Figure 8 shows the number of participants who said yes to the proposed factors.

- Local traffic density at port approaches was seen by the majority 19 – (86%) of the respondents to be a hazard when making port to pick up pilot, transit or anchor.
- Master and bridge team area experience is also regarded as one of the top hazard factor to consider by 19 – (86%) participants.

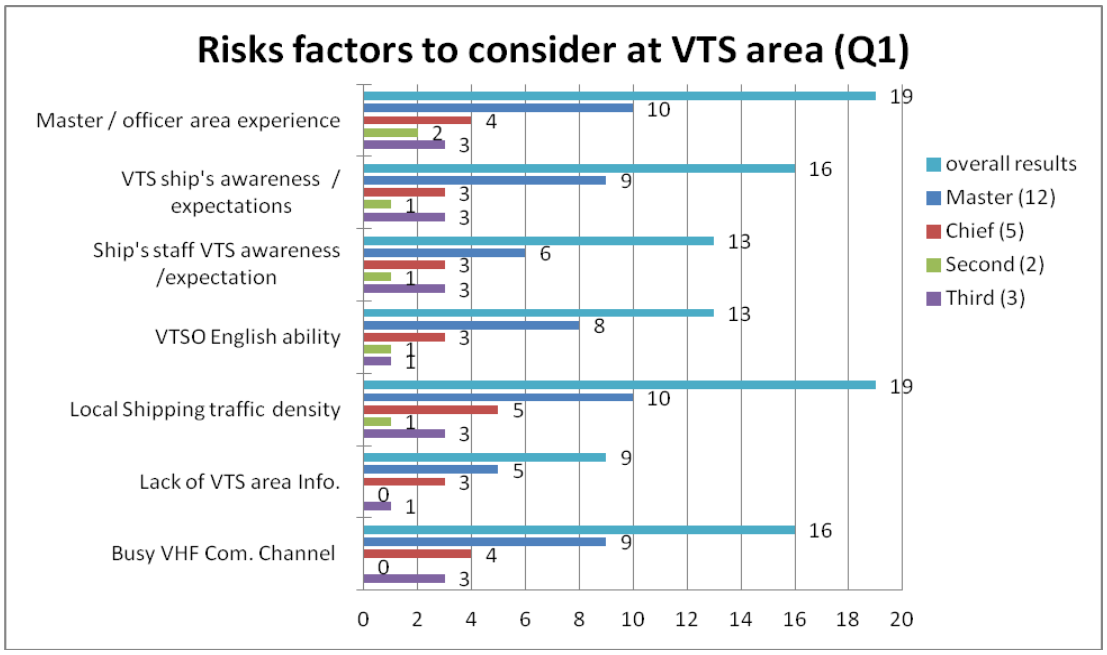

Figure 8 - Additional risk factor to consider at port approaches.
Source: Author, 2011.

- The absence of VTSO sea experience was seen by 16 – (73%) participants to be a hazard that may lead to an accident. The same number of participants regard busy VTS/ports VHF channels to be a risk at port approaches, which may result in the loss of vital information.

- VTSO English language ability and ships' staff VTS awareness was also regarded to be of an issue to consider when identifying hazard factors at port approaches. However, only 13 – 59% agreed with this.
- The use of VTS communication markers and lack of VTS information were not regarded to be important by ships' staff, only 9 – (41%) out of 22 said yes to these as seen in Figure 9.

4.2.2 Research Question 2

How can VTS (operators) be involved in accident development and what is their liability?

The data in Table 5 are based on anonymous responses to questionnaire sent out to seafarers (22) and VTS centres or competent authorities. Data was filtered and categorized for displaying as per Table 5.

Table 5 - Accidents development factors and accountability at VTS area.

Research Qstn	Item	No. of Participants				Sum
	Total Population	12	5	2	3	22
	Ranks on board	Master	Chief	Second	Third	
Q 2	Vessel tracking /monitoring and warning	12	4	2	3	21
	Number of incidents and near misses	11	4	1	3	19
	Risk analysis for VTS area	9	3	1	2	15
	Availability of standard operation procedures	10	4	1	2	17
	Use of VTS communication marker	6	2	1	0	9
	VTSO accountability Inside VTS area	9	3	2	2	16
	VTSO accountability Outside VTS area	3	0	0	0	3

Source; Author, 2011

Results of the questionnaire brought about differing findings to the questions as follows:

- **VTS main functions, regulations and procedures:** The majority of the responses have a common agreement that failure by VTS to track, monitor and warn vessels inside a VTS area is a major factor in accidents that can be avoided by VTSO action. Also for the VTS authority failure to exercise due diligence in having the standard operation procedures as per the results showed 17- (77%).
- **Use of VTS communication pre-fix (markers):** The use of communication markers was not consider to be a problem for the majority of the respondents; however, 9- (40%) regarded it to be of concern to them.

- **Risk analysis for VTS area:** Seafarers 15- (68%) did see the absence of undertaking a risk analysis for the VTS area to be of a contributing factor to maritime accidents at port approaches. Nine out of twelve masters think that it plays a vital role in accident development (see Appendix I.01).

In addition to IMO / IALA guidelines, the following (as shown in Figure 8) is regarded to be of interest by shipboard staff to include when regulating a VTS area to better mitigate maritime accidents at port approaches.

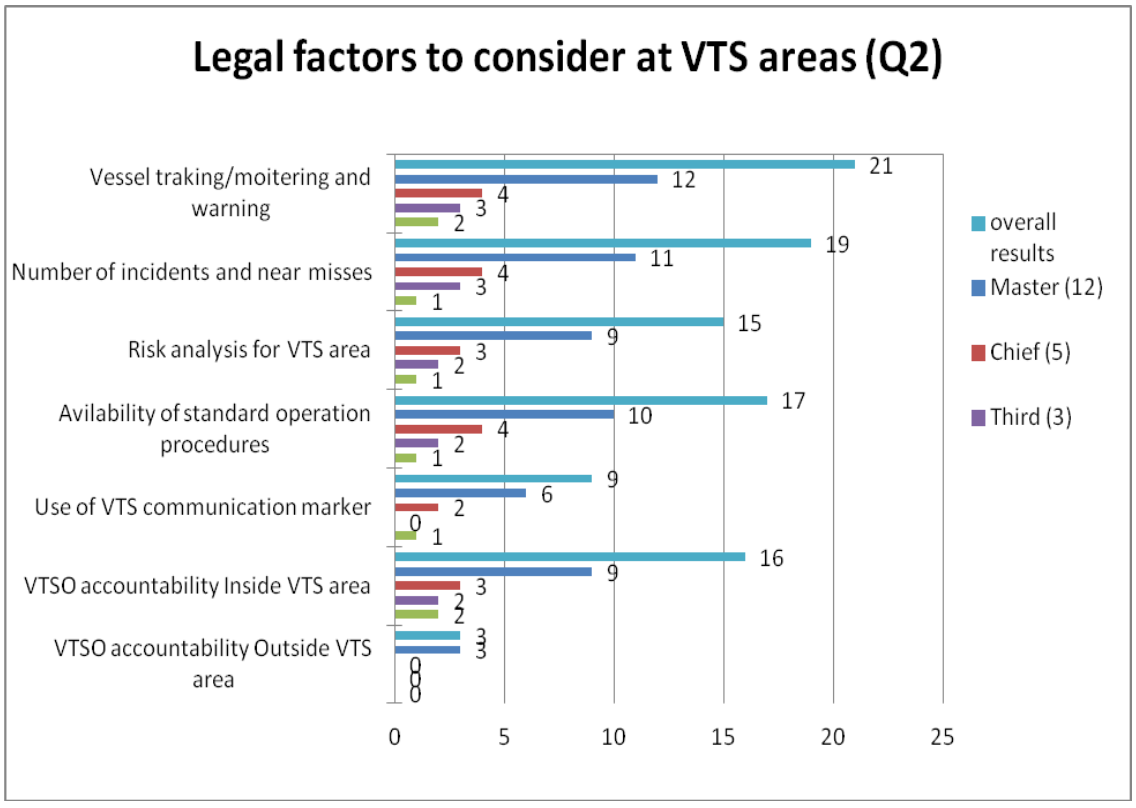

Figure 9 - Factors seen to be of legal importance at port approaches.
Source; Author, 2011

4.2.3 Research Question 3

Are there KPI or benchmarks for VTS to be regarded as good for mitigating maritime accident?

The findings as received from anonymous responses to the questionnaires are shown in Table 6; the findings include responses received from seafarers and VTS centres or competent authorities . Data was filtered and categorized for displaying as per Table 6.

Table 6 - Suggested VTS Benchmarks/ KPI factors

Research Qstn	Item	No. of participants				Sum
	Total Population	12	5	2	3	22
	Ranks on board	Master	Chief	Second	Third	
Q 3	Vessel tracking/monitoring and warning	12	4	2	3	21
	Safety advices/information	11	5	2	3	21
	Number of incidents and near misses	11	4	1	2	18
	navigational assistance	9	4	2	3	18
	traffic organisation instructions	8	3	2	3	16
	risk analysis for VTS area	9	3	1	2	15
	Availability of standard operation procedures	10	4	1	0	15
	Use of Communication Marker	6	2	1	3	12

Source; Author, 2011

The main quesionnaire results are as shown below :

- The ability of the VTS centre to track, monitor and warn vessels within the VTS area was agreed upon by 21- (96%); however, there were some who wanted the service to extend beyond the area, i.e. to warn the vessel whenever it is in danger.
- 16- (73%) of the partacipents, said yes to reciving traffic organisation instructions from VTSO. Other services (parameters), as they apear on Figure 10, are accepted at a higher rate as per the results displayed in the same figure.

- In addition to the proposed factors, some of the respondents suggested other factors such as qualification of the VTSO, sea experience, and number of complaints registered at the VTS.

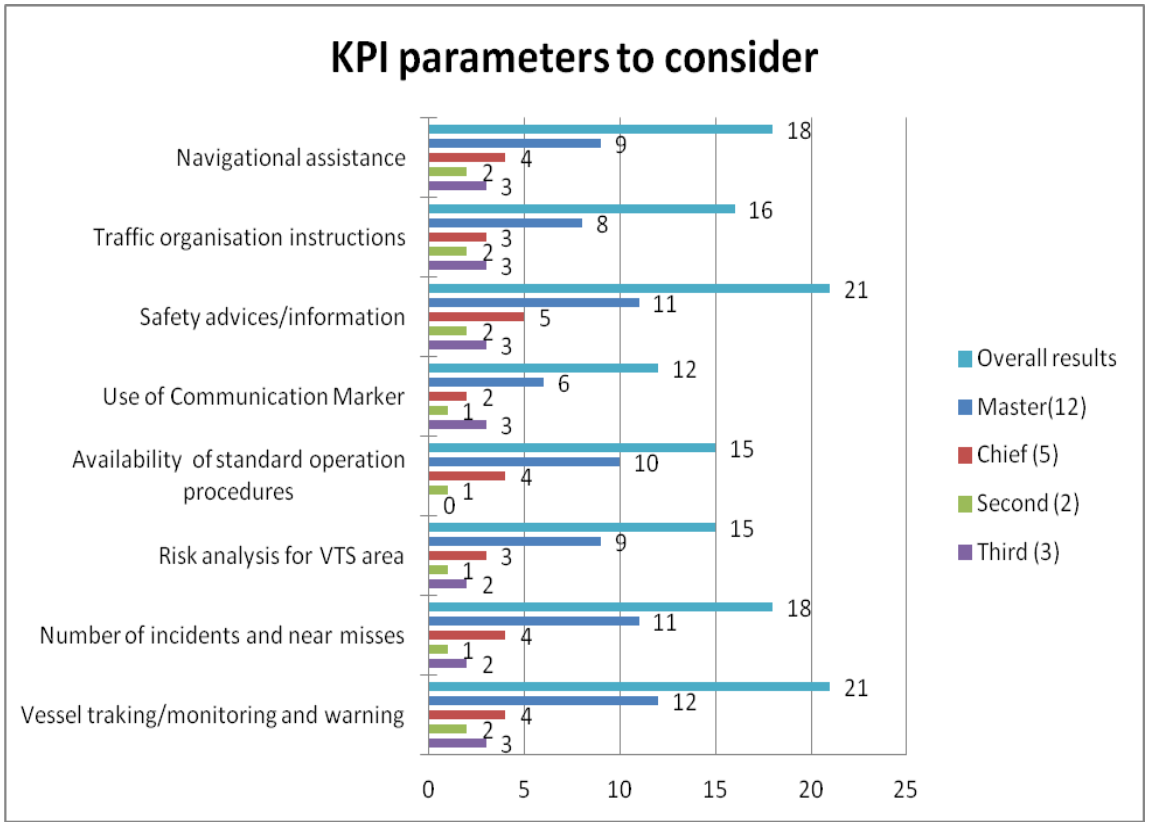

Figure 10 - Factors to consider when setting up VTS centre KPI
Source: Author, 2011

4.3 Other findings

The questionnaire was also sent to various competent VTS authorities / centres. Different questions were asked regarding the availability of national regulation for VTS activities, bodies responsible for VTS operations and the announcement of the VTS at national and international levels (see Appendix F) . About 50 potential participants were invited to take part in the survey; only fourteen centres participated in the survey, 4 from the Middle East, 3 from Africa, 4 from the European Union, 2 from the Far East and Canada (see Appendix J).

Figure 11, shows participants who said yes to the questions asked.

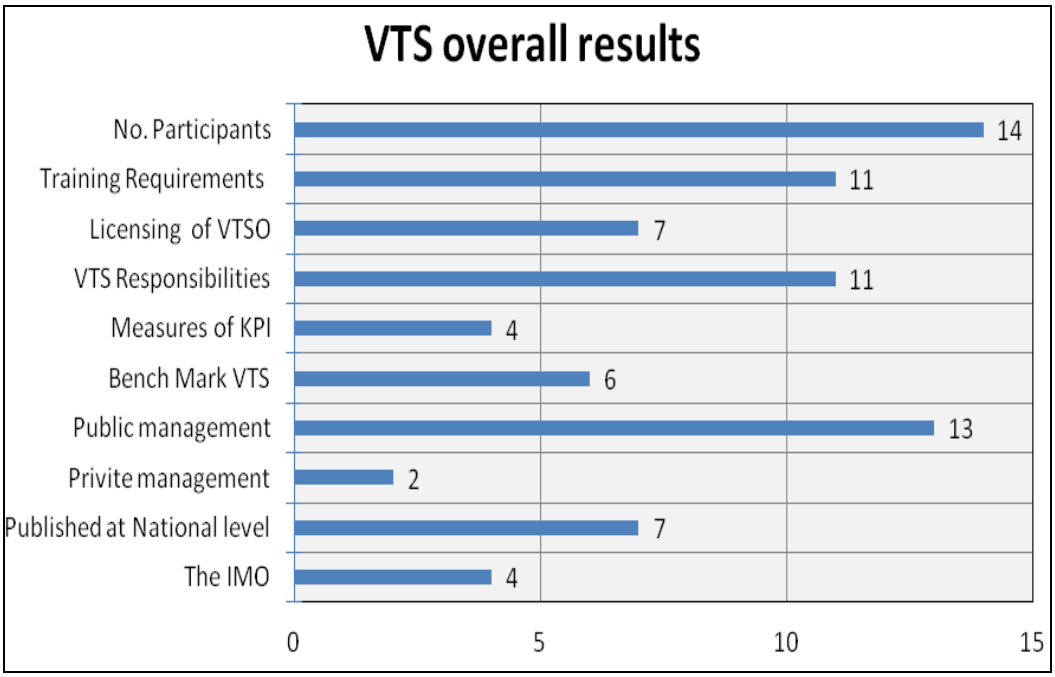

Figure 11 - VTS centers positive responses to questions.
Sources: Author 2011

The questionnaire findings revealed that:

- VTSO training requirements were not a national requirement more than VTS authority administrative settings; 11 of 14 centers had this as a requirement for VTSO.
- VTSO licensing was a requirement in only half of the participated VTS centres.
- VTS responsibilities have been highlighted in national law within 11 participants.
- KPI was regarded as the last priority in some VTS centres (only 4 out of 14 centers said they have some sort of KPI) while others regarded benchmarks to be in line with IALA VTS Guidelines in which all EU VTS were doing annual internal as well as external audits every five years. Matters of internal procedures were audited only, thus missing the quality at a global level.
- The management of most participated VTS centres are managed by the public sector, while there are few others which are managed by private oil terminals that only cover traffic management to and from the terminal.
- The publicity of established VTS centres has been kept close to the stakeholders, mainly ships and pilots via "Admiralty List of Radio Signals Vol. 6 & 7"[18]. Only 7 published their VTS centers at national level while IMO was informed only about 4 out of 14 VTS centres surveyed.

[18] As per MCA, MGN 239, "Statutory Harbour Authorities should provide the details above to the MCA, who are the UK's Competent Authority for VTS, for compilation of the UK VTS database and to UKHO for promulgation of appropriate details in the Admiralty List of Radio Signals Volume 6 and on Admiralty Chart(s). Ports with VTS services are encouraged to provide details to IALA for promulgation on the World VTS Guide website". Furthermore, UK HO, ALRS Vol. 6. Gives list of ports around the world together with procedures to be followed for reporting and ordering of pilots.

4.4 Summary

The questionnaire results was structured around the three research questions. The findings is summarized below:

- Local shipping traffic density and shipboard officers' area experience were seen as the highest hazards at port approaches that need to be mitigated.
- Busy VHF communication channels and VTSO sea experience are also considered as hazard factors.
- Lack of regulating VTS functions (tracking, monitoring and warning) is seen as the main accidents development factor in VTS areas.
- The absence of accidents and near miss records were regarded as another accident waiting to happen, if the new risk was not eliminated or minimized.
- VTS centers ought to have its own standard operation procedures, while VTSO should be held accountability but not liable for accidents within VTS areas.
- Not all VTS centers require a VTSO to be licensed, but have some sort of training requirements at VTS authority requirement level.
- Few VTS centers have consider the measure of KPI or benchmarks. However it is restricted to operational procedures of internal and external audit program.
- The centre's ability to optimize and control its services has been regarded as a benchmark by seafarers.
- Most VTS are managed by the public sector, yet some oil terminals have their own VTS traffic control. While the publications of VTS centres at national and IMO level have not been adequate, they were limited to information contained within the ALRS.

CHAPTER 5 RESULTS OF INTERVIEWS

5.1 Introduction

In this section the result of the interviews conducted is presented. Semi structured interviews were used to either confirm the results derived from the questionnaire or to find additional information. A list of questions were used to facilitate the interview process (see Appendix H). The participants were either VTS experts (one), managers (two) and regulators (one).

5.2 Questions and interview transcripts

Answers to the interview questions will be summarized; however, quotations from the interviews will be used during the discussion process in the next chapter.

5.2.1 Risks with ships when approaching port area

- The spoken language on board and difficulties to communicate with the ships in the VTS area.
- Perception of the bridge team regarding the area to be transited, and pushing of safety factors to the limit especially maximum allowable draft and transit time.
- Failure to keep the AIS "on" for easy ships' identification by the VTS centre.
- Lack of coordination between VTS centres and pilots.
- Difficulties in detecting ships not required to carry AIS on board.

5.2.2 Factors to consider when evaluating the performance of the VTS centre

- Meeting the IMO and IALA guidelines and standards.
- Different KPI for each VTS area location especially between river and sea VTS centers.
- Reporting of information to EMSA in line the EU directives.

5.2.3 VTSO contribution to accident development at port approaches

- Overloading the bridge team with non-relevant information.

- Failure to monitor the allocated VTS area during VTSO watch period.
- Lack of coordination with the pilots and other allied services.

5.2.4 Regulating the interaction of VTSO with ships inside and outside VTS area

- The VTS area is divided into subsections and two types of VTSO are allocated to interact with ships inside the VTS area; the pilot boarding area (area of high risk as commented by one interviewee) is controlled by a VTSO, who is also a pilot; other areas are also divided according to the risks involved.
- The issue of outside VTS area is left to the Coast Guard (CG), where a VTSO spots a ship doing something which is not correct, he will advice the CG to deal with it.
- For inside VTS area, a VTSO is expected to follow the procedures in place; however, outside the VTS area, there is no written regulations in place, but the VTSO is expected to use his best judgment at the time to avoid an imminent disaster (two interviewees concur).

5.2.5 VTSO accountability with regard to accidents inside the VTS area

- He will be held questionable to the VTS manager and only administrative disciplinary actions will be taken including the removal from the centre, but he will not be held liable, yet the centre may be held liable in accordance with the national law.
- The issue of legal liability has never been discussed with the VTSO as it has never been an issue till now.

5.2.6 Harmonization of VTS regulations around the world

All interviewees agree that regulating VTS to an international standard will benefit the ships more, but may require refining in accordance with the regional regulations and requirements e.g. EU rules may not be welcomed in other countries. IMO / IALA guidelines may be used as a minimum requirements for VTS centers.

CHAPTER 6 DISCUSSION

6.1 Introduction

This chapter reviews and advances the study findings presented in the previous chapter. It is organised in four sections. The first section briefly summarizes the observations concerning the wide spread use of the word VTS within the ports and terminals domains around the world. This is followed by a discussion of the study findings as it relates to the three research questions. The last section gives a summary of the chapter.

6.2 Observations

It is not hard to find the wide spread use of the word VTS within the shipping domain, which may and may not reflect the true meaning of the VTS as assumed and defined by the IMO and the IALA. Looking at ALRS Vol. 6 & 7 for port controls and pilots will give a spectrum of locations around the world to apparently mean port control (or LPS) more than the true meaning of a VTS. Moreover, some VTS centres are becoming multi-task centres in quest of optimising resources and the onset of practicalities. This was endorsed via the EU research project (MarNIS) into "Maritime traffic management and control" which developed the "Maritime Operational Services (MOS)"[19] concept in recognition of the VTS practical settings.

[19] EU Commission, Thematic Research Summary: "Intelligent transport systems", Transport Research Knowledge Centre. Prepared by Zuzana Sitavancová & Martin Hájek, Date 02/04/2009. http://www.eurosfaire.prd.fr/7pc/doc/1257760616_trs_intelligent_transport_systems_2009.pdf

6.3 Discussion of research questions

The overall objective of this study is to highlight the way VTS is regulated by international bodies, namely IMO and IALA, and also the implication of such regulations on mitigating maritime accidents at port approaches. Furthermore, the purpose of this study was to first investigate risk factors that need to be mitigated in areas of port approaches as perceived by shipboard officers. The second part was to look at VTS centre involvement in accidents developments and their liabilities. The last section describes VTS benchmarks/KPI parameters.

A total of twenty two (22) participants' answers to the questionnaire were received from seafarers, fourteen (14) from VTS centre / competent authorities and four (4) interviews were conducted together with the other sources of data gathering mechanisms were used to answer the three research questions discussed in chapter four. Through a qualitative data analysis, the following is a discussion of the study as it relates to the three questions and other findings.

6.3.1 Research Question 1

What are the risks that need to be mitigated in areas of port approaches?

The risk level exonerated on ships increases as it comes closer to land especially port approaches, while port risk levels fluctuated subject to many factors (external "beyond the control of the port authority, like weather and abnormal conditions including the departure from international law requirements" and internal "management policies"). Many maritime safety authorities around the world especially in the EU countries have made it mandatory to carryout risk assessments for their operations accordingly. Guidelines for Port & Harbour Risk Assessment and Safety Management

Systems in New Zealand[20], gives a "Derived Hazard List" for port approaches; however, it does not apparently take into account shipboard influenced risk factors. The US Coast Guard, also apply a similar strategy "Ports And Waterways Safety Assessment (PAWSA)" within port approaches / VTS areas, as "the process is expected to provide a basis for making best value decisions for risk mitigation investments, both on the local and national level"[21]. The PAWSA which was conducted in 2008 for the New York VTS area, post the allision of MT Axel Spirit[22] with Ambrose light on the early morning of 03rd Nov 2007, among the risks identified was VTS VHF saturation, which was also identified from the research survey bearing in mind that the PAWSA was conducted by a New York VTS stakeholder workshop. Other results "Congestion, Traffic Mix" were also similar.

Master and officer area experience "19- (86%)" was regarded to be as one of the highest risk factor in the VTS area, inspite of SOLAS requirements regarding voyage planning while using the on board publication to draw a true picture of the area; again the MT Axel Spirit highlighted the same points the survey found.

The area experience and local shipping traffic density draws on the same number 19-(86%) of agreement, which was not a surprise to the researcher. It could be an acceptable risk to the local people who are so used to seeing it every day. Thus the foreign master may get himself into problems just by the mere fact of fear because of his perception, yet he could be right if the port has never handled such a ship before, so that is why they go onto simulation before accepting it.

[20] New Zealand Maritime Safety Authority, 2004. Guidelines for Port & Harbour Risk Assessment and Safety Management Systems.

[21] US CG Ports And Waterways Safety Assessment (PAWSA), sited 18.09.2011 from http://www.navcen.uscg.gov/?pageName=pawsaMain

[22] US NTSB, Accident Report; NTSB/MAR-09/02, PB2009-916402. Sited on 20.07.2011 from http://www.ntsb.gov/doclib/reports/2009/MAR0902.pdf

The response to any question varied subject to the shipboard rank (experience) and age. Therefore, masters gave wiser answers to certain questions, while junior officers responded well to e-related questions (electronically track and monitor vessels' movements). Apparently the questions were a surprise to the shipboard staff, especially with regard to the question of "ship board knowledge regarding VTS".

The widespread use of UK HO ALRS Vol. 6 & 7 regarding port controls "VTS" suppressed the "Lack of VTS area information question" as being one of the hazards regarded by ships' staff. In this respect the UK HO was asked by e-mail "if they had any specific prerequisite for VTS to be listed as VTS in the ALRS". The answer was "NO" it is done based on network and direct questions to individual ports / terminals.

VTSO English language command was not regarded to be a hazard to port approaches. This could be because more ports are realising the importance and have ensured that only those that have good English command are operating the VTS centres or terminal operators are becoming global. However, a Canadian Coast Guard study[23]concluded that "the matter of foreign language, the service received is acceptable to well. The service, however, is not of very great importance and therefore is not likely to ensure VTM effectiveness in reducing marine accidents". One interviewee commented that a risk may arise because of the spoken language on board and difficulties to communicate with the ship in the VTS area, but today there is always a young officer on board who can speak English.

Captain Terry Hughes, reiterate in his article[24], what apparently every VTS centre is challenged with when communicating with ships "one of the problems facing VTSOs is language and the difficulties in communicating with multilingual crew abroad vessels,

[23] Canadian Coast Guard VTS study conducted and published in Oct. 1984. The study is related to marine risk reduction and the VTS.

[24] Hughes, T. (2011). When is VTS not a VTS? Part 2. *Port Technology International*, Edition 45 -VTMIS & Aids to Navigation. Retrieved on 20.08.2011 from http://www.porttechnology.org/images/uploads/technical_papers/40-43.pdf

particularly in times when a vessel is navigating in a haphazard way" (Hughes, 2011, p.2).

The use of VTS communication markers was considered to be a problem for 9- (41%) out of which are 6 masters. The recent grounding accident[25] highlights a true example of the use of communication markers, the VTSO said as cited by a MAIB report "All ships standby, all ships standby. **Maersk Kendal warning to you**. Ahead of you is Samho Jewelry, Samho Jewelry, What is your intention over?", so was this master out of the six who said yes?

The study along with other contextual literature, recognises the need to regulate such risks; however, identifying elements of risk in its general term that may be used around the world proved to be a more difficult task than anticipated, because there are certain elements that are inherited within any given industry. The concept of listing risks to be mitigated at port approaches will be unique to each port approach. Other factors to consider in addition to the standard risks factors, would also include: ship's staff area experience, VTSO ship's awareness and expectations, local shipping traffic density and finally busy VHF working channels as the study survey showed. It is apparent that certain risk factors have been solved in certain regions (EU) but is surfacing in another region (like the PSC issue) "The Arabian Gulf is of mixed quality VHF channels seriously overcrowded" (NI, 1999 survey). The elimination of such risk in some region is due to robust VTS regulations coupled with strict enforcement mechanisms, including fines and the use of technology to capture evidence at VTS centers.

[25] Marine Accident Investigation Branch, Report No 2/2010 March 2010, Report on the investigation of the grounding of *mv Maersk Kendal* on Monggok Sebarok reef in the Singapore Strait on September 16th 2009. Retrieved on 20.08.2011 from http://www.maib.gov.uk/cms_resources.cfm?file=/Maersk_Kendal_Report.pdf

6.3.2 Research Question 2

How can VTS (operators) be involved in accident development and what is their liability?

The findings suggest that 21– (96%) of the participants believe that lack of properly regulating the VTS main functions "vessel tracking / monitoring and warning" can lead to an accident development, "The master and chief officer became irritated by the frequent interventions by VTMIS, which resulted in important information from VTMIS being missed"[26]. It has been suggested by one of the interviewee that the quality of the information is important at that instant **"is it too much information, which is no good, because then I get crazy, all this information or is it the information which I need at that moment",** basically given the correct relevant information to the correct ship which will aid the master to take the appropriate action and to avoid bridge team information overload. Other matters of concern to ships' staff as the Nautical Institute council survey[27] found out is "VTS can demand information which can be very distracting at critical times", miss-coordination between pilot, VTS and terminals.

IMO resolution A.857 (20), 2.2 stipulates responsibilities and liability of contracting governments when setting up a VTS. Among others, it should ensure that there is legal basis for the operation of the VTS in accordance with national and international laws. Furthermore, in 2.2.4, the liability element is highlighted to be as "a case-by-case basis in accordance with national law". Thus a VTS authority is asked to consider "the legal implications in the event of a shipping accident where VTS operators may have failed to carry out their duty competently". The survey result coincided with the IMO resolution regarding the liability issue, in which 16– (73%) believed that a VTSO should be held accountable if an accident occurred within his VTS area because of negligence which

[26] MAIB accident investigation report into the grounding of MV Maersk Kendal in Singapore strait, 2009.
[27] The Nautical Institute council survey, on VTS conducted on 20.12.1999 by CJP/JEM and was presented at the International Harbour Master Association (IHMA) in Malta 2006.

has to be proven in the court of law. The recent grounding[28] of M.V. Alva on 17th August 2011 in the Sound North East of Ven Island brought about major change within the coverage of the Sound VTS to cover the whole bay, thus extending the VTS responsibility area. Furthermore, it was confirmed by one of the interviewees (VTS manager) that VTSOs are held accountable if an accident takes place within the VTS coverage area but is not liable. A Canadian VTS study[29] affirms this settings "a definite statement of liability with respect to a regulator for an act of omission occurring in the course of his or her duties can only be made by the courts based on the facts of a specific case". Similar setting is followed in the UK, South Africa, the US and others. Furthermore, the issue of VTS "duty of care" was the centre point of "master mariners of Australia congress"[30], it was highlighted among other points that "a VTSO duty of care is to be proactive and act in such a way as to improve safety (i.e. watch and warn) and to prevent vessels from grounding or colliding and thereby causing damage to the environment. VTSO may be liable should they fail to warn".

19– (86%) of the participants regarded the failure by the VTS centre to capture and regulate near misses or accidents that may have departed from the original perceived risk assessment can be a contributor to accidents developments in VTS areas in the future. Associated British Ports (ABP) has incorporated a new risk management tool (Accident and Incident Reporting Module) within its "Port Marine Safety Management System"[31] by the European MarNIS Project in June 2008. The database compares existing hazards due to actual accidents or incidents which had already been assessed and should be reviewed or it is a new hazard that need to be added and assessed for future reference.

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[28] Turkey Seanews. *Drunken Latvian captain ran ship aground*. Sited on 10.09.2011 from http://www.seanews.com.tr/article/ACCIDENTS/68832/andlt;alva-Aground-Drunken-Captain/

[29] Canadian Coast Guard, October 1984. *Vessel Traffic Services Study - Final Report*. Transport Canada.

[30] Buuren, E.V. April 2011. *VTS in Australia, perspectives for pilots and mariners*. Master Mariners of Australia Congress. Norton Rose Australia.

[31] ABP, (2009). *Port Marine Safety Management System*. Marine Advisor's Office. Version 1.1. sited on 19.09.2009 from http://www.southwalesports.co.uk/files/abp%20sms%20manual%20ver1_1.pdf

The use of communication makers was not considered to be a problem for the majority of the respondents; however, 9- (40%) regarded it to be of concern to them and was limited to officers originating from the Middle East, ISC, and Africa, which is apparently because of either the VTS centers in the above regions are not using the correct VTS communication protocols or the ability of officers to switch mode as they communicate with different regional VTS centres.

Captain Terry Hughes, ask if the VTS regulations were lacking, "Over the years VTS has been developed almost in a total legal vacuum and only now, when the systems are actually in operation in many parts of the world, are hurried questions being asked about regulatory aspects, legal responsibilities and liability".

The study found that regulating the VTS functions is a necessity to mitigate maritime accidents at port approaches rather than leaving the VTS centres and its stakeholders with the dilemma, while offering issues that were considered by the survey participants to be of importance which ought to be included when regulating VTS in addition to the national settings.

6.3.3 Research Question 3

Are there KPI or benchmarks for VTS to be regarded as good for mitigating maritime accident?

VTS centres have always worked in silence with regard to their achievements in evading many accidents involving ships approaching ports or transiting VTS areas. The researcher believes good VTSO centres are self disciplined and work with instinct rather than rigid procedures. However, not all VTSOs will have that basic instinct which will render the quality of the centre; henceforth, the need to establish some KPI to ensure consistency all the time.

Captain Drouin, indicates in an article[32] that safety must have objectives "without safety performance measurement criteria (established safety objectives) middle management is cast adrift and without clear direction ... what gets measured gets done or If you don't measure it you can't manage it". In this case, an accident free VTS area as indicated by one interviewee "no accident because VTS operator". The finding conclude the ability of a VTS centre to effectively track, monitor and warn ships in time, is regarded by 21–(95%) shipboard officers to be as a good indicator for the performance of that centre.

The type of safety advice and information were also seen by 21–(95%) to be a good indicator to realize the quality of a VTS centre. The quality of such information usually sets the officers perception every time they are in the same area, in which the advice or information given saved the ship from danger.

Availability of navigational assistance within a VTS area and its quality are also seen to be a good KPI. This is a very important service that a VTS centre can offer especially to a bridge team who lacks area experience, and wishes to follow the port's regulations. The NI survey shows participants considering the "most useful advice is guidance up to

[32] Seaways, 2010, Oct. Article by Capt Paul Drouin MNI, *The building blocks of a safety culture.*

pilot embarkation" especially during restricted visibility. Furthermore, this service is strictly regulated in the UK in accordance with MGN 401[33].

Other factors to consider when setting up a KPI is the number of accidents and near misses a VTS area may be allowed to have before it is considered as a bad performer; 19- (86%) participants saw this issue to be of high priority, so this will give ships' staff and other maritime organizations something to think about with regard to giving technical assistance (in the case of the IMO) and may be beneficial to improve the safety records which are reflected in the number of accidents in a VTS area. This strategic issue will have to be decided by upper management, which is subjected to the available resources and the risk acceptability criteria. IALA Guideline no. 1055, gives reference to the issue of "Performance Measures" undertaken to evaluate the effectiveness of the VTS, e.g. the analysis of accidents and incidents. This shows the importance of the issue that the maritime community would like to see actions taken to reduce it or eliminate it.

An important distinction to make, is the lowest number within the reaserch survey regarding the use of VTS communication markers. Only 9– (41 %) who said yes; therefore the respondents did not know the issue or were able to switch communication mode between regions.

Two other important findings to note are: masters' agreement (10 out of 12 masters) regulating the VTS via Standard Operation Procedures (SOP) compared with third officers. The second one is, masters' reluctance to accept traffic organistion instructions (8 out of 12 masters) compared to other ranks. This is apparently in line with the masters' overall responsibilies and the region they come from. Full frequancy distribution among officer rankings and the population perception regarding elements of KPI should included in any VTS centre as seen by the shipboard staff is shown in Table 6.

[33] In accordance with MGN 401, Navigational Assistance Service (NAS) may only be undertaken by a dedicated VTSO. See item 7.7.4 on page 9 of the same MGN for more details.

In addition to the research study findings, Professor Allen, indicated in his report several items that may be used as KPI / benchmarks: “the use of case study in evaluating VTS policy options”, the use of selected scenarios for VTSO training that cover the full range of the VTS management including the full range of environmental conditions for the area, acceptable analytical methods to fully measure the effectiveness of VTS systems relative to the factors that affect operational risks, ability to provide good quality and unambiguous information. In one interview, the participant indicated the use of the actual cases for refining actions should have been taken, in addition to amending the procedures.

6.4 Other findings

In order to explore the way VTS are regulated around the world, about 50 e-mails were sent worldwide, but only 14 questionnaires were received from different regions as shown in Appendix K.

VTSO training was a requirement set by the VTS authority more than a national regulation set by the competent authority. Apparently, this training was not done in accordance with IMO and IALA guidelines in some regions, especially developing countries.

Licensing of VTSOs was again a matter of VTS authority rather than an obligation set by the competent authority. As the study showed, there is no general acceptance of VTS licensing in the Middle East (0) since it is only guidelines compared with STCW Certificate of Competency (CoC.) The majority of VTS centres around the world are managed by public service (government), but there are few which are dually managed e.g. Tampa and Los Angles in the US; however, there are oil terminals around the world who are running VTS for shipping traffic organising into the terminal which are apparently not regulated as per the IMO / IALA guidelines.

Almost all VTS centres have no measures of KPI or benchmark to work on, for example 4 out of 14 centres had some sort of KPI which is actually adhered to IALA audit requirements as stipulated in Chapter 18 of the IALA VTS manual 2008. KPI or benchmarks are not regarded as priority in most of the centres because they are more concerned with the day to day running of the centre.

From a business prospective, a KPI is something that management support team should prepare and give it to the VTSO to adhere to. On the other hand, Canada does have KPI for the VTS centres which is set by the centre, thus not uniform all over Canada. The issue of performance evaluation was highlighted in a recent IMO document[34] regarding VIMSAS coastal States obligation findings "Another concern is the lack of evaluation of performance on safety of navigation and SAR", which include the VTS as per the pre-audit IMO VIMSAS questionnaire. A research study about the "Quality Coastal State Pilot Study"[35] remarked within the report among other things, the difficulties in identifying the quality of VTS due to non respondence of the competent authorities around the world.

6.5 Summary

Questionnaire results are further discussed in this chapter. The discussions triangulated all available information from contextual information, questionnaire results and information from other relevant studies (introduced in this chapter) in order to correlate the findings and the existing results where available.

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[34] IMO, 2010. *Review of the code for the implementation of mandatory IMO instruments*. FSI 18/INF.7. Retrieved on September, 21 2011 from WWW: http://docs.imo.org/Search.aspx?keywords=%22FSI+18%2fINF.7%22

[35] Internal Report to the Round Table of Shipping Organisations on the Criteria and Measures of a "Quality Coastal State" Study. Maria Anne Wagtmann & Kristen Nedergaard, Univ. of Southern Denmark. Retrieved on Augest, 29 2011 from WWW: http://www.dendanskemaritimefond.dk/public/dokumenter/Full%20Report%20Quality%20Coastal%20State%20Pilot%20Study%20sa.pdf

CHAPTER 7 CONCLUSIONS and RECOMMONDATIONS

7.1 Conclusion 1

Risk is always in a state of flux at port approaches, requiring proactive mitigation measures

Hazard identification generally comprises a combination of both creative and analytical techniques, and the emphasis has lately been on the creative and proactive methods involving the primary VTS staff (VTSO) in quest of shifting from static hazards identified in the past. IMO and IALA do not offer a readymade hazard / risk list for port approaches apart from the conditions requiring the consideration of VTS deployment.

The study along with other contextual literature, recognises the need to regulate all type of risks; however, identifying elements of risk in its general term that may be used around the world proved to be a more difficult task than anticipated, because risks are always in a state of flux at port approaches, also there are certain elements that are inherited within any given industry. The concept of listing risks to be mitigated at port approaches is unique to each port approach around the world and is subjected to several factors, yet there are factors that need to be considered, which can be generalised. This would include ship's staff area experience, VTSO ship's awareness and expectations, local shipping traffic density and finally busy VHF working channels as the study survey showed.

7.2 Conclusion 2

Regulating VTS, international guidelines and a national obligation toward VTS stakeholders

Regulating main VTS functions in a harmonized way around the world is seen by shipboard officers as a necessity towards mitigating maritime accidents at port approaches. Responsibilities and liability of contracting governments are set out in IMO Resolution A.857 (20), 2.2. It should ensure that there is legal basis for the operation of the VTS in accordance with national and international laws while the liability element is highlighted to be as "a case-by-case basis in accordance with national law".

Failure by VTS centres to track, monitor and warn vessels inside VTS areas is a major factor in accidents that can be avoided by VTSO actions, which is regarded by some courts as negligence by the VTS centre in exercising due diligence and is left to the court to decide. A VTSO is held accountable but not liable (subject to national statues settings) if an accident occurs within his VTS area

The absence of VTS area risk analysis, standard operation procedures, the VTS demand for information at critical times, and finally miss-coordination between pilot and VTS are contributing factors to maritime accidents at port approaches. Furthermore, the failure by the VTS centre to capture and regulate near misses or accidents that may have departed from the original perceived risk assessment can be a contributor to accidents developments in VTS areas.

7.3 Conclusion 3

VTS benchmarking to justify its importance in mitigating maritime accidents

Almost all VTS centres have no measures of KPI or benchmarks to work on; some centres are regarding the adherence to IALA audit requirements as stipulated in Chapter 18 of the IALA VTS Manual 2008 as a benchmark for their work.

KPI or benchmarks are not a priority in most of the centres because they are more concerned with the day to day running of the centre. Apparently KPI is seen by VTS centres as a strange word coming into the VTS maritime safety domain that may distract the VTS centre from its main objective of preventing accidents in the VTS area.

Benchmarking / KPI is a managerial domain more than a VTSO concern. Introducing benchmarks at VTS centres will leverage the port in marketing its self as safe port as supported by the VTS KPI. The use of indicators can be used for internal process improvements as well as external towards optimizing the resources available.

The study recognized at least four main operational KPIs that may be used to measure the performance of the VTS; ability of the VTS centre to track, monitor and warn vessels within the VTS area, delivery of navigational assistance, safety advice / information, qualification of the VTSO and his sea experience, and the number of complaints registered at the VTS.

7.4 Self reflection on the study

This section gives a reflection of the researcher's account of this study. The study is explanatory in nature and tries to establish the importance of different elements as perceived by shipboard officers, which ought to be incorporated when regulating VTS centres. The research was focused on studying shipboard officers' perceptions with regard to elements that ought to be regulated from an operational point of view.

The survey questionnaire answers was drawn from different nationalities, age and ranks found onboard ships. Regulating VTS is a government obligation but is affecting VTS stakeholders including shipboard officers. Taking their mind set into the risk identifications, quality index and the issue of VTS centre behaviour when delivering its services can add more value to the regulations. Regulated VTS centres as required by IMO and IALA guidelines, should look for other matters that can capitalise on their current investment to mitigate maritime accidents at port approaches. One way is to educate the VTSO on the impact of their actions with regard to the behaviour of their counterparts on board ships and the magnitude of cultural differences.

The issue of a VTS doing multi-tasks at port approaches means more software is needed that can automatically capture and store information ready to be retrieved by others like customs, pilots, and health officer. This will have to be recognised by the maritime society as a whole and by the VTS authority. The issue of culture remains a great obstacle in public dominated employees service, where complaints or a past record data base are not desirable in some regions. Sooner or later, VTS centres will be asked to justify the enormous amount of money spent on the establishment of VTS in a trendy outsourcing environment. The purpose of regulating VTS is to create more efficient processes in order to fulfil the objectives of maritime safety towards safer, secure oceans and cleaner environment.

7.5 Lessons learned from the study

The researcher's education and experience in the field of shipping helped in understanding the needs of regulating VTS in any country irrespective of its international obligations. The elements of technology have always fascinated the researcher's curiosity into finding better use for it to enhance the work process, yet studying at World maritime University (WMU) brought about new prospective into regulating matters in an international setting.

Choosing this topic exposed the researcher to a variety of opinions and gave an in depth prospective on how VTS centres are regulated including the importance of different elements within those regulations together with the issue of liability in court.

There are certain experts who have written in English about the subject of VTS; however, there may be others who have written in different languages and the researcher was not able to read the same.

After doing this research, it is apparent to me that, the study will help the Bahrain Maritime Safety Department in regulating its current VTMS towards fulfilling its obligations as per SOLAS Chapter V, regulation 13 regarding VTS. Further, this will answer many of the IMO VIMSAS audit questions.

7.6 Recommendations

The study aimed to explore and explain how VTS regulations can mitigate maritime accidents at port approaches while understanding the value of regulating elements as perceived by the shipboard officers. The findings have important implications to competent VTS authorities. Based on the study results, the researcher in this section proposes the following strategies /recommendations (implications);

1. Risks at port approaches have not been static over the years. It is highly recommended that the VTSO be trained on how they can identify new or unpredictable risk at their VTS area.
2. The establishment of new risk register at VTS centres, preferably in electronic format to capture new risks as they are experienced by the VTSO for later assessment.
3. Identified risks (old and new) should be disseminated to all VTSOs serving at the VTS centre.
4. When regulating VTS at a procedural level, due care should be taken to include a chapter on dealing with new risks as they develop.
5. The accountability and liability issues of the VTSO in case of an accident in the VTS area should be brought to the attention of the VTSO in accordance with the national law and internal procedures.
6. Table top exercises should be done monthly to cover new discovered risks and ways of dealing with them.
7. While it is often possible to distinguish between requirements, expectations, and wants at any one point in time, VTS customers' view may change. Measuring customers' satisfaction on a regular basis is a must to study this shift which is necessary to sustain maritime safety levels at VTS areas and to re-engineer the process as required. It is also important to measure the employees' satisfaction with their current jobs and benefits.

8. When setting up KPI for VTS centres, the stakeholders' opinion including shipboard officers' visiting the area should be considered.
9. Cross government agency meetings including pilots should be highly encouraged to discuss customers' service problems and develop acceptable practical solutions for them.
10. Publication of VTS data on the web is recommended to minimize the use of the telephone which may distract the VTSOs from their main job.
11. The concept of Maritime Operational Services (MOS) should be adopted by the IMO to optimise developing nations' resources when offering technical assistance.

7.7 Summary

The study intended to show how VTS regulations can mitigate maritime accidents at port approaches, thus achieving a manageable maritime accident rate aimed at protecting the environment.

Through an explanatory inductive research the qualitative research method was used while utilising semi-structured interviewing techniques and questionnaires in addition to observations to collect primary data. At the same time secondary data were used to conclude the findings. The implication in this chapter and the findings presented in the previous chapters, highlight the need to regulate VTS centres in a harmonized way and to ensure a high standard VTS is maintained throughout the VTS operations. It is concluded that risks are always in a state of flux at port approaches, requiring holistic mitigation via different risk mitigation options including regulating the VTS centre and area. Regulating VTS is an international quest and a national obligation toward protecting VTS stakeholders interest in view of maintaining a high standard of maritime safety. VTS benchmarking / KPI will justify its importance in mitigating maritime accidents within VTS areas and at port approaches. This requires a focus on leadership, strategy, internal process, customers and meaning-full ROI in order to yield the desired results.

7.8 Future Research

Finally, the findings suggest that regulating a VTS should include matters that can affect the power to better mitigate a maritime accident at port approaches, while counting the consequences of failing to exercise due care and diligence, in the watching eye of the shipboard officers and the maritime community as a whole towards sustainable VTS center quality.

New policies and guidelines are required to draw the relationship between the VTS outsourcing (operated by oil terminals or private port operators “in developing nations”) and the competent VTS authority /government to encompass State obligations, and needs while sustaining commerciality at any given time.

Future research should explain new policies and guidelines in the wake of port privatizations to ensure that VTS if outsourced, remain the IMO member States’ responsibility that can be audited in 2015 through the IMO Mandatory Audit Scheme.

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APPENDICES

Appendix A: Hazards identified at port approaches

- Unregulated Notification Of Arrival (NOA) for vessels arriving port approaches.
- Difficulties in identifying non SOLAS vessels by VTS and by other ships.
- VHF channel crowded.
- Port location, Congestion and traffic density.
- Environmental conditions; visibility (including time of the day, shore side lightings), tide and current, wind speed and direction.
- Available Aids to navigation (AtoN) at port approaches and their status.
- Anticipated vessel encounters; multi direction port approaches like New York, and most European ports.
- Difficulty in knowing other vessel's name, type, position, cargo on board, vessel operating conditions, if applicable, and intended navigation movements, as reported.
- Temporary measures in effect, deployed by local authority e.g. new wreck markings.
- A description of local harbour operations and conditions, such as ferry routes, dredging, local shipping traffic, pattern of local traffic, and so forth.
- Anchorage availability, limit markings and marking on charts.
- Availability of up to date local VTS information.
- Ships' collision, allision, fire, explosion, grounding (while under power of drifting), leaking, damage, injury or illness of a person aboard, or manning shortage, Certificate of Competency (CoC) and experience of ships' staff.
- Cargo transfer operations in open water.
- Types, size, and draft of ships visiting the port.
- Port's infrastructures and availability of reliable support (tugs, pilots, VTS).
- Out of date charts and nautical publications on board ships.
- Lack of frequent sea bed survey and chart updating.
- Presence of wrecks and obstructions along fairway or sea lane, port approaches.

Sources;

IMO resolution A.857(20), IALA Guidelines 1018. (2005), US CG regulations ;

33 C.F.R. PART 161—VESSEL TRAFFIC MANAGEMENT, Title 33 - Navigation and Navigable Waters http://law.justia.com/cfr/title33/33-2.0.1.6.29.html &

33 C.F.R. PART 160—PORTS AND WATERWAYS SAFETY—GENERAL, Title 33 - Navigation and Navigable Waters. http://law.justia.com/cfr/title33/33-2.0.1.6.28.html . Retrieved on August 28th 2011.

Appendix B: Marine Accident Investigation Branch (MAIB) e-mail response

From: MAIB <MAIB@dft.gsi.gov.uk> Tuesday - August 16, 2011 3:54 PM
To: "s11110@wmu.se" <s11110@wmu.se>
Subject: F0007927 Regulating VTS, Dissertation

Attachments: Your right to complain.pdf (9 KB) [View] [Open] [Save As]
20110816 f0007929 All.pdf (76 KB) [View] [Open] [Save As]
20110816_f0007927_Possible_VTS_edited.xls (48 KB) [View] [Open] [Save As]
20110816_Possible_VTS_Edited (2).pdf (300 KB) [View] [Open] [Save As]

Dear Abdulhusain

Our ref F0007927

I am writing to confirm that the Marine Accident Investigation Branch (MAIB) of the Department for Transport has now completed its search for the information which you requested on 22 July and 27 July 2011.

We attach

(1) Tables showing number of Accidents and both Accidents and Hazardous Incidents that occurred while "On passage" or "Entering or leaving port". These are broken down to shown the vessel type and allow you to choose either cases in UK waters or cases to UK vessels. Please note that you cannot add together the figures for UK waters and UK vessels, if they are added then many cases will be double counted.

Non-UK Flagged vessels are not required to report accidents to MAIB unless they are both within the 12 nautical mile limit and carrying passengers to or from a UK port, however if we hear about an accident inside the 12nm limit we will have recorded it. We will not have recorded cases involving Non-UK Flagged vessels that occurred outside the 12nm limit (Unless a UK vessel was also involved).

(2) Details of cases where VTS is mentioned in the text, these are for you to review and generate your own figures for cases where VTS may have contributed to an incident. To aid you in this details are also provided in an Excel spreadsheet. We suggest that you make a working copy of the spreadsheet and delete from it those cases you consider irrelevant.

Cases can be cross referenced by means of the Case Number which is the first item to appear in both the spreadsheet and the summaries. Please note that there may be up to 6 rows of data per case number (6 vessels in one Accident).

Cases have only been selected if they involve either a Merchant Vessel of 500gt or more or a fishing vessel. However the spreadsheet and the document contain details of all vessels in the selected cases. The extra vessels have a grey background in the spreadsheet so that you can easily remove them if required.

When using the details provided to generate statistics please note that you should choose to present data for either cases where the 'Vessel Nationality' is "U.K." or cases where the 'Territorial Water' is "U.K.".

In keeping with the spirit and effect of the Freedom of Information Act, all information is assumed to be releasable to the public unless exempt. The Department may, therefore, be simultaneously releasing to the public the information you requested, together with any related information that will provide a key to its wider context.

If you are unhappy with the way the MAIB has handled your request or with the decisions made in relation to your request you may complain within two calendar months of the date of this mail by replying to me at the above address. Please see attached details of the Department for Transport's complaints procedure and your right to complain to the Information Commissioner.

If you have any queries about this email, please contact me. Please remember to quote the reference number above in any future communications.

Tracey Hill
Freedom of Information Officer
Marine Accident Investigation Branch
Mountbatten House
Grosvenor Square
Southampton
SO15 2JU
Tel +44 (0)23 8039 5531
Fax+44 (0)23 8023 2459
maib@dft.gsi.gov.uk

Appendix B.01: Specimen of accidents reports summary involving VTS

Selected incidents reported to MAIB where text contains "VTS", "VTIS" or "Vessel Traffic" - 2005-2010

Case Number **0642/2010** **16/05/2010** **Hazardous Incident**
Regulation **Hazardous Incident** Status **Closed**
Location **Port/harbour area** **Northern Irish**
Belfast
Natural Light **Light** Sea State **Moderate**
Visibility **Good (5 - 10)** Wind force Range **4-6**
Tanker/combination carrier Dead **0** Injured **0** **No Damage**
Oil/Chemical tanker Flag **Malta**
10321.00 gt
When: **Entering or leaving port** **0.01** Reg. L **145.00** LOA
Deck
Bridge procedures
Passage Planning/Track Monitoring
Position monitoring not frequent enough
Human factor
System - Crew Factors
Inadequate management of physical resources
Procedures inadequate
Poor Decision Making
Speed or heading not altered - risk not appreciated
Human factor
People

At 1826 a tanker gave 15 minutes notice of her arrival at the fairway buoy. VTS advised the vessel to remain 1 mile east of the Fairway Buoy to board the pilot. The vessel had an SOG of 11.8 kts. At 1831 the pilot boat departed from the shore. At 1839 the tanker was proceeding at 11.9 kts, the pilot boat called the vessel and requested that it reduce speed to 7 kts in preparation for boarding the pilot. At 1842 the tanker had passed the fairway buoy at sog 10.2kts. The pilot boarded at 1846 and found the vessel in 6.5 to 7.0m of water, the vessel had a draft of 6.4m and was only 1 cable form a 5m sounding. The vessel, under the con of the pilot turned to port and entered the main channel. The master was on the bridge when the pilot boarded, it appears he was more concerned about maintaining course and speed for the pilot boat than monitoring his own vessels position. The harbour master has issued a notice to mariners reminding vessels of the requirements to report movements to VTS and of the designated areas for pilot boarding. VTS were not very pro active in this incident. The harbour master intends holding two meetings with VTS staff over the next two weeks to discuss recent incidents and to remind them of the need to be pro active.

Source; Prepared by MAIB for Abdulhusain Abdulla F0007927 16 August 2011

A specimen page out of 87 pages containing accidents reports summary involving VTS interaction (positive or negative) or contained within an accident report, sent by MAIB – UK.

Appendix B.02: Specimen of accident cases summary involving VTS

Case Number	Incident Type	Location Of Accident	Harbour Limit	Vessel Type	Damage	Happened When
0447/2005	Collision	Port/harbour area	Singapore	Dry cargo	Minor Damage	Entering or leaving port
1882/2005	Collision	Port/harbour area	Tilbury	Dry cargo	Material Damage	Entering or leaving port
0447/2005	Collision	Port/harbour area	Singapore	Dry cargo	Minor Damage	Entering or leaving port
0075/2006	Contact	Port/harbour area	Milford Haven	Fish catching/processing	Material Damage	Entering or leaving port
0164/2006	Contact	Port/harbour area		Dry cargo	Minor Damage	Entering or leaving port
1156/2006	Hazardous Incident	Port/harbour area	Dublin	Passenger	No Damage	Entering or leaving port
1279/2006	Grounding	Port/harbour area	Hull	Dry cargo	No Damage	Entering or leaving port
0004/2006	Contact	Port/harbour area	Plymouth	Dry cargo	No Damage	Entering or leaving port
1156/2006	Hazardous Incident	Port/harbour area	Dublin	Dry cargo	No Damage	Entering or leaving port
0124/2007	Hazardous Incident	Port/harbour area	Liverpool	Other commercial		Entering or leaving port
0172/2007	Collision	Port/harbour area	Liverpool	Passenger	Material Damage	Entering or leaving port
0526/2007	Collision	Coastal waters	Humber	Tanker/combination carrier	Material Damage	Entering or leaving port
1493/2007	Contact	Coastal waters	Belfast	Dry cargo	Material Damage	Entering or leaving port
1501/2007	Grounding	Port/harbour area		Other commercial	No Damage	Entering or leaving port
1652/2007	Contact	Coastal waters	Southampton	Dry cargo	No Damage	Entering or leaving port
0124/2007	Hazardous Incident	Port/harbour area	Liverpool	Dry cargo		Entering or leaving port
0172/2007	Collision	Port/harbour area	Liverpool	Dry cargo	Minor Damage	Entering or leaving port
0526/2007	Collision	Coastal waters	Humber	Dry cargo	Material Damage	Entering or leaving port
0160/2008	Grounding	Coastal waters	Clyde	Dry cargo	Minor Damage	Entering or leaving port
1157/2008	Contact	Port/harbour area	Killingholme	Tanker/combination carrier	Material Damage	Entering or leaving port
0081/2008	Grounding	River/canal	Thames	Tanker/combination carrier	No Damage	Entering or leaving port
0420/2008	Collision	River/canal	Manchester	Tanker/combination carrier	Minor Damage	Entering or leaving port
0420/2008	Collision	River/canal	Manchester	Dry cargo	Minor Damage	Entering or leaving port
0765/2008	Collision	Port/harbour area	Immingham	Dry cargo	Minor Damage	Entering or leaving port
1197/2008	Contact	Port/harbour area	London	Dry cargo	Minor Damage	Entering or leaving port
1214/2008	Grounding	River/canal	Humber	Dry cargo	No Damage	Entering or leaving port
1226/2008	Grounding	Port/harbour area		Other commercial	No Damage	Entering or leaving port
1460/2008	Contact	Port/harbour area	Heysham	Dry cargo	Material Damage	Entering or leaving port
1590/2008	Grounding	River/canal	Humber	Dry cargo	No Damage	Entering or leaving port
0195/2009	Hazardous Incident	Coastal waters		Passenger cargo	No Damage	Entering or leaving port
1451/2009	Collision	Coastal waters	Humber	Dry cargo	Minor Damage	Entering or leaving port
1643/2009	Hazardous Incident	Coastal waters		Dry cargo	No Damage	Entering or leaving port
0070/2009	Contact	Port/harbour area	London	Dry cargo	Minor Damage	Entering or leaving port
0144/2009	Fire/Explosion	River/canal	Humber	Dry cargo	Material Damage	Entering or leaving port
0195/2009	Hazardous Incident	Coastal waters		Dry cargo	No Damage	Entering or leaving port
0717/2009	Hazardous Incident	Port/harbour area	Aberdeen	Dry cargo	No Damage	Entering or leaving port
0642/2010	Hazardous Incident	Port/harbour area	Belfast	Tanker/combination carrier	No Damage	Entering or leaving port
0978/2010	Hazardous Incident	Port/harbour area	Humber	Tanker/combination carrier	No Damage	Entering or leaving port
0146/2010	Contact	River/canal		Tanker/combination carrier	Material Damage	Entering or leaving port
1378/2010	Hazardous Incident	Port/harbour area	Liverpool	Passenger		Entering or leaving port
0107/2005	Accident To Person	Coastal waters	Humber	Dry cargo	No Damage	On passage
1686/2005	Grounding	Coastal waters		Dry cargo	Material Damage	On passage
1751/2005	Hazardous Incident	Coastal waters		Tanker/combination carrier		On passage
1751/2005	Hazardous Incident	Coastal waters		Dry cargo		On passage
1789/2005	Hazardous Incident	Coastal waters		Dry cargo	No Damage	On passage
0088/2006	Hazardous Incident	Coastal waters	Humber	Tanker/combination carrier	No Damage	On passage
0088/2006	Hazardous Incident	Coastal waters	Humber	Tanker/combination carrier	No Damage	On passage
1443/2006	Hazardous Incident	Coastal waters		Dry cargo		On passage

Source; Prepared by MAIB for Abdulhusain Abdulla F0007927 16 August 2011

Above is an excel file sheet modified by the researcher for the purpose of data compilation and graphic presentation.

Appendix C: List of IALA publications for VTS matters

Publication	Date
IALA Recommendations	
V-102 Application of "User pays" principle to Vessel Traffic Services	March 1998
V-103 Standards for Training and Certification of VTS personnel	May 1998
V-119 Implementation of Vessel Traffic Services	September 2000
V-120 Vessel Traffic Services in Inland Waters	June 2001
V-125 Integration and Display of AIS and other information at a VTS Centre	December 2004
V-127 Operational Procedures for Vessel Traffic Services	June 2004
V-128 Operational and Technical Performance Requirements for VTS equipment	June 2007
A-123 The Provision of Shore Based AIS	June 2007
A-124 AIS Shore Station and Networking Aspects Relating to AIS service	June 2003
A-126 Use of AIS in Marine Aids to Navigation	June 2007
Note: Prefixes: 'V' indicates a recommendation produced by the VTS Committee, 'A' by the AIS Committee.	
IALA Guidelines	
1014 Accreditation of VTS Training Institutes	May 2001
1017 Assessment of training requirements for existing VTS Personnel, candidate Operators and the revalidation of VTS Operator Certificates	June 2001
1018 Risk management	June 2000
1027 Designing and implementing simulation in VTS training	June 2002
1032 Aspects of Training of VTS Personnel relevant to the introduction of AIS	June 2003
1045 Staffing Levels at VTS Centres	December 2005
1046 Response plan for marking new wrecks	June 2005
1055 Preparing for a voluntary IMO Audit on VTS Delivery	December 2006
1056 Establishment of VTS Radar Services	June 2007
IALA Manuals	
VTS Manual (Previous editions 1993, 1998, & 2002)	2008
Aids to Navigation Guide (Navguide - Edition 5) (Previous editions 1990, 1993, 1998 & 2001)	2006
IALA Model Courses of Training	
V-103/1 VTS Operator – Basic training	March 1999
V-103/2 VTS Supervisor – Advancement Training	March 2000
V-103/3 VTS Operator & VTS Supervisor – On-the-Job Training	March 1999
V-103/4 VTS OJT Instructor	December 2001

Source; IALA VTS Manual 2008, p 49

Appendix D: National legislation, statutory instruments and regulatory guidance

Country	Primary Legislation	Secondary Legislation/ Statutory Instruments	Guidance at National Level	Byelaws
Australia	At National Level: (Applies to REEFREP only) Navigation Act 1912 *Australian Maritime Safety Authority Act 1991* At State Level : Queensland: Transport Operations Marine Safety Act 1994 (TOMSA 1994).	Marine Orders Part 56 (Applies to REEFREP only). Marine Orders are subordinate legislation, made under the Navigation Act Regulations under the TOMSA Act 1994	REEFGUIDE – A Shipmaster's Guide to the Torres Strait and the Great Barrier Reef.	N/A at national level Regional Harbour Masters in the State of Queensland can direct shipping within port limits
Hong Kong SAR, China	The Shipping and Port Control Ordinance, Chapter 313 of the Laws of Hong Kong SAR.	Sub-legislation: The Shipping and Port Control Regulations (Chapter 313A of the Laws of Kong Kong SAR)	NA	NA
Italy	Law (7 March 2001, Number 51, art 5) Maritime Transport. Pollution Prevention and Maritime Traffic Monitoring.	Inter-Ministry Decree (28 January 2004) Establishment of VTS system	Coast Guard Directive 001, National Regulations for VTS	Local Coast Guard VTS Procedures – User manuals Local Coast Guard Ordinances
Japan	Law for Preventing Collisions at Sea (1977) Maritime Traffic Safety Law (1972) Port Regulation Law (1948)	Various Cabinet Orders and Regulations	Various notices	
Netherlands	Scheepvaartkeerswet (Shipping Traffic Act 1988	Various Statute Orders and ministerial Decrees	None	Port or local area byelaws established by the local competent authority.
United Kingdom	General: Harbours, Docks and Piers Act 1847 Harbours Act 1964 European Communities Act 1972 (Sect 2 (2)) Merchant Shipping Act 1995 (Sect 85 & 86) Local: An Act setting out the governance of each port by name. (e.g. The Milford Haven Conservancy Act 1983)	Statutory Instruments: Merchant Shipping Notices (MSN) Harbour Revision Orders Harbour Empowerment Orders The Merchant Shipping (Vessel Traffic Monitoring and Reporting Requirements) Regulations 2004	**Port Marine Safety Code** and accompanying **Guide to Good Practice** Marine Guidance Note (MGN) MGN Nos 180,238,239 and 240. Designation by the Maritime and Coastguard Agency as National Competent Authority to comply with the EC Vessel Traffic Monitoring Directive.	Harbour Byelaws applicable to each port and its locality. Established by the local competent authority, subject to the granting of relevant powers in local legislation.
United States of America	Port and Waterway Safety Act of 1972, as amended.	Code of Federal Regulations 33CFR, part 161.	US Coast Guard Marine Safety Manual.	Established by each local VTS Authority in the form of 'User's Manuals

Source: IALA VTS Manual 2008, p 42

Appendix E: Shipboard officers questionnaire regarding VTS

Shipboard Officers Ships' Master / Officers.

Dear Sir/Madam.

Please give below your kind opinion to the following questions;

1. What are the risk /hazardous (s) when approaching port area (pilot station) from sea?

a) Busy VHF communication channel	A; Yes.	B; No.
b) Lack of VTS area information.	A; Yes.	B; No.
c) Local shipping traffic density.	A; Yes.	B; No.
d) VTSO lack of good English Language	A; Yes.	B; No.
e) Ship's staff VTS awareness/expectation	A; Yes.	B; No.
f) VTSO ship's awareness / expectations	A; Yes.	B; No.
g) Master's/officer area experience	A; Yes.	B; No.

Others...

2. What would be factors to evaluate the performance of a VTS centre (s)?

a. Vessel tracking/monitoring and warning	A; Yes.	B; No.
b. Number of incidents and near Misses	A; Yes.	B; No.
c. Risk analysis for VTS area	A; Yes.	B; No.
d. Availability of standard operation procedures	A; Yes.	B; No

Others (specify).....

3. Do you see the use of VTSO communication marker (pre-fix) as a contributor in accident development at port approaches? A. Yes B. No

4. Do you trust information given to you by VTS centre regarding?

   a. Safety advices /information. A. Yes. B. No
   b. Traffic organisation instructions. A. Yes. B. No
   c. Navigational assistances. A. Yes. B. No

5. Do you think a VTSO should be held accountable if an accident takes place?

   a. Inside VTS area. A. Yes. B. No
   b. Outside VTS area ; A. Yes. B. No

6. Please specify your;

   a. Rank; .....
   b. Age;.....
   c. Nationality; .....

Thank You

Appendix F: VTS centre / Competent Authority questionnaire regarding VTS

Dear Sir/Madam.

Please give below your kind answer to the following questions

1. How many VTS centres do you have? And what type are they?
2. Do regulations exist in your National law regarding VTS centres, VTS personals as highlighted below and VTS area?
    a. Training requirements; A. Yes. B. No
    b. Licensing of VTSO A. Yes. B. No
    c. VTS responsibilities/obligation A. Yes. B. No
    d. Measures (KPI) to evaluate VTS A. Yes. B. No.

Other VTS regulations...

3. How do you benchmark (KPI) the quality of your VTS?
4. Who is responsible for VTS operation?
    a. Public sector (coast guard, port authority, etc).
    b. Private sector (port operator / oil terminal, etc)
5. Are all VTS centres published at ;
    a. National level (within the law/ reg.) A. Yes. B. No
    b. The IMO. A. Yes. B. No.

Others. (specify).;.....

Region;

Appendix G: Specimen of e-mail sent along-with the questionnaire

Dear Sir / Madam,

The purpose of the questionnaire below, is to address a question regarding "Regulating VTS to mitigate maritime accidents at port approaches". Your participation in this research questionnaire is important and will be greatly appreciated. Since no names are requested, there will be complete confidentiality. Your opinion is important to understand the situation, please take few minutes to answer the questions below.

Many thanks in advance and warmest regards,

Abdulhusain Mansoor Abdulla
Student for "MSc in Maritime Affairs"
World Maritime University (WMU) Malmo
Sweden.

Appendix H: Interview questions to VTS manager

1. What are the risk(s) associated with ships when approaching port area (pilot station) from sea?
2. What factors do you consider when evaluating the performance of your VTS centre (s)?
3. Do you see the VTS officer ability as a contributor in accident development at port approaches? A. Yes B. No
4. Do you have regulations regarding the VTSO engagement with ships inside and outside VTS area to prevent an accident?.
5. Do you think a VTSO should be held accountable if an accident takes place at port approaches?.
6. Do you think regulating VTS to International standard can better mitigate maritime accidents at port approaches?

Appendix I: Shipboard officers feedback compilation matrix

Shipboard officers questionnaire feedback compilation (Master copy)

Q 1	What are the risk when approaching port area (P.Stn) from sea?																								
	Item / Particpents	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22		
	Rank on board																								%
	Age																								
	Region (Nationality)																								
a	Busy VHF Com. Channel																							0	0.0
b	Lack of VTS area Info.																							0	0.0
c	Local Shipping traffic density																							0	0.0
d	VTSO English ability																							0	0.0
e	Ship's staff VTS awareness /expectation																							0	0.0
f	VTS ship's awarness / expectations																							0	0.0
g	master / officer area experience																							0	0.0
	Others																								

Q 2	What would be factors to evalute the performance of a VTS centre?																								
	Item / Particpents	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22		
a	Vessel traking/moitering and warning																							0	0.0
b	Number of incidents and near misses																							0	0.0
c	risk analysis for VTS area																							0	0.0
d	avilability of standard operation procedures																							0	0.0
	Others																								
*																									

Q 3	Do you see the VTSO communication pre-fix as a contributor in incident development at port approaches?																								
	Item / Particpents	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22		
	response to question only	0																						0	0.0

Q 4	Do you trust information given to you by VTS centre regarding ?																								
	Item / Particpents	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22		
a	Safety advices/information																							0	0.0
b	traffic organisation instructions																							0	0.0
c	navigational assistance																							0	0.0

Q 5	Do you think a VTSO should be held accountable if an accident takes place?																								
	Item / Particpents	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22		
a	Inside VTS area																							0	0.0
b	Outside VTS area																							0	0.0

Source: Author,2011

Appendix I.01: Questionnaire results frequency distribution summary table

Frequancy Distribution Summary

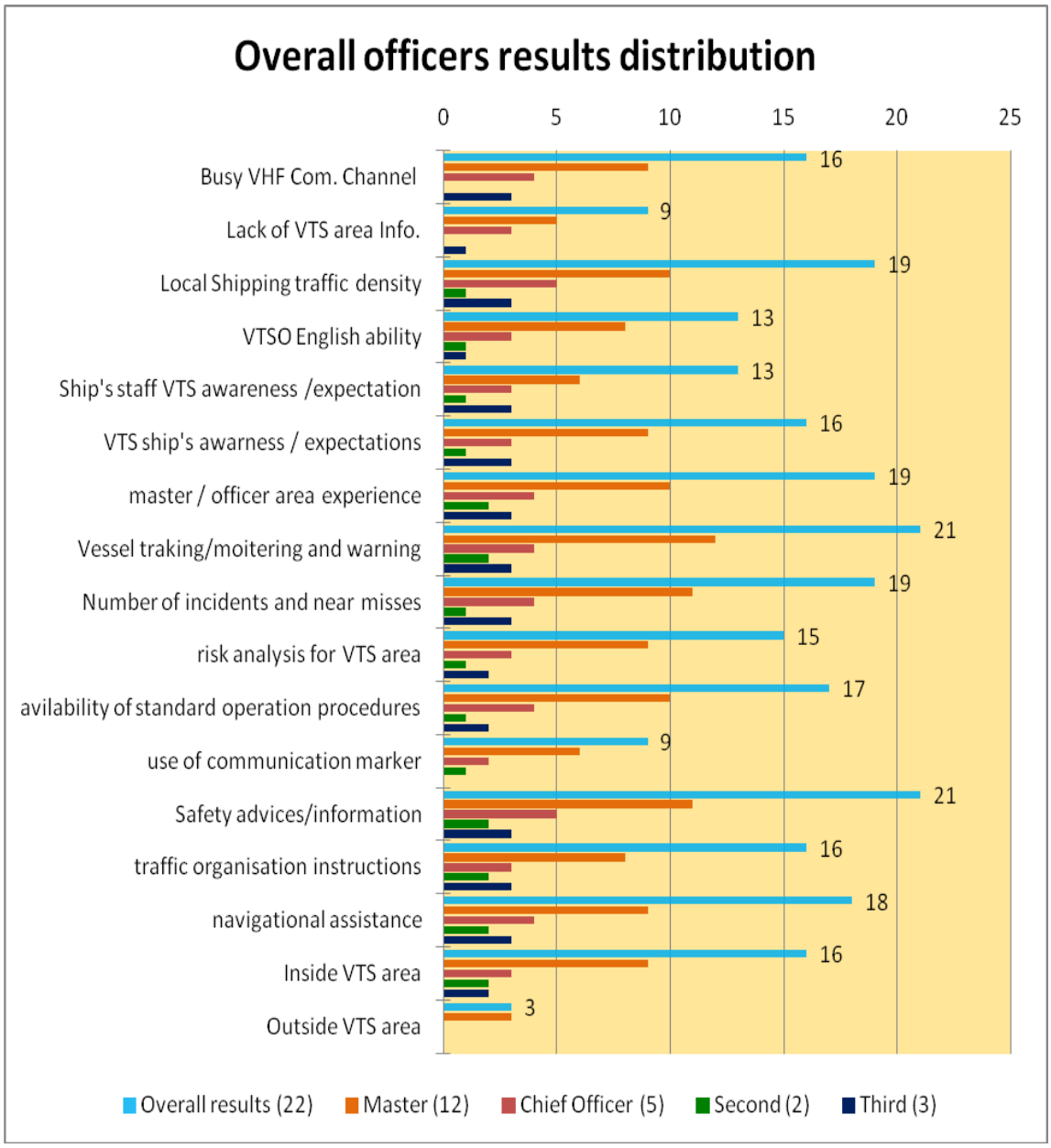
10.09.2011

Qst / Rank		Items	Ranks on board				Sum	Age Group			Sum		Regions					Sum
			Master	Chief	Second	Third		A	B	C			FE	ME	EU	A	ISC	
		No. of Participents					0				0							0
Q 1	a	Busy VHF Com. Channel					0				0							0
	b	Lack of VTS area Info.					0				0							0
	c	Local Shipping traffic density					0				0							0
	d	VTSO English ability					0				0							0
	e	Ship's staff VTS awareness /expectation					0				0							0
	f	VTS ship's awarness / expectations					0				0							0
	g	master / officer area experience					0				0							0
Q2	a	Vessel traking/moitering and warning					0				0							0
	b	Number of incidents and near misses					0				0							0
	c	risk analysis for VTS area					0				0							0
	d	avilability of standard operation procedures					0				0							0
Q3		response to question only					0				0							0
Q4	a	Safety advices/information					0				0							0
	b	traffic organisation instructions					0				0							0
	c	navigational assistance					0				0							0
Q5	a	Inside VTS area					0				0	said						0
	b	Outside VTS area					0				0	both						0

Source: Author,2011

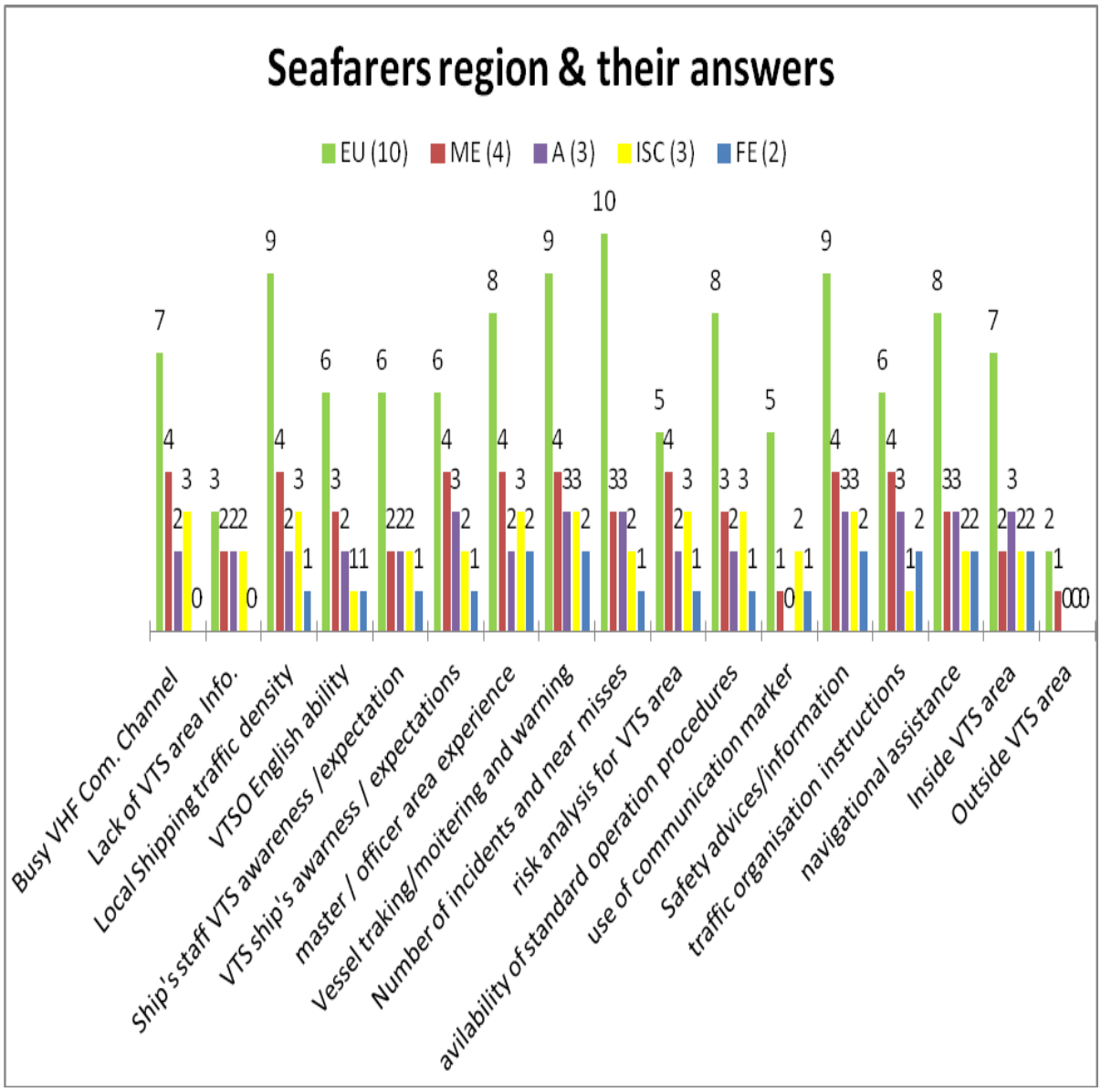
The above table shows the number of participants who said yes to the proposed factors.

Appendix I.02: Questionnaire results distribution chart



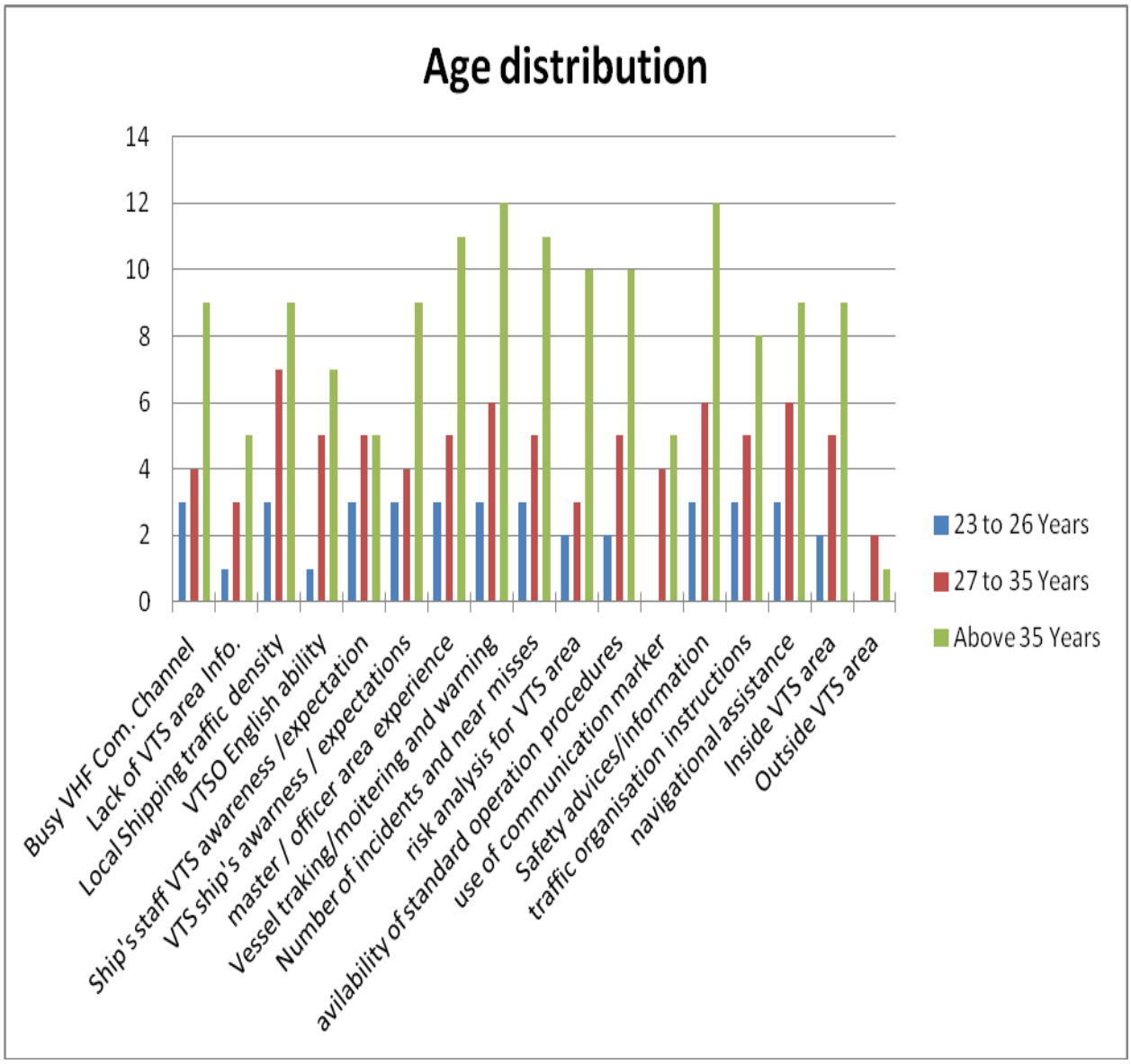
Source: Author,2011

Appendix I.03: Seafarers region results distribution chart



Source: Author,2011

Appendix I.04: Age distribution and results chart



Source: Author,2011

Appendix I.05: Masters' response analysis table

Master (M)											Total	12
Qst / Rank		Answers		Age Group			Regions					
			Y	A (23 - 26)	B (27 - 35)	C (35 +)	FE	ME	EU	A	ISC	others
		No. of Participents										
Q 1	a	Busy VHF Com. Channel										
	b	Lack of VTS area Info.										
	c	Local Shipping traffic density										
	d	VTSO English ability										
	e	Ship's staff VTS awareness /expectation										
	f	VTS ship's awarness / expectations										
	g	master / officer area experience										
Q2	a	Vessel traking/moitering and warning										
	b	Number of incidents and near misses										
	c	risk analysis for VTS area										
	d	avilability of standard operation procedures										
Q3		response to question only										
Q4	a	Safety advices/information										
	b	traffic organisation instructions										
	c	navigational assistance										
Q5	a	Inside VTS area										
	b	Outside VTS area										

Q 1 What are the risk when approaching port area (P.Stn) from sea?
Q 2 What would be factors to evalute the performance of a VTS centre?
Q 3 Do you see the VTSO communication pre-fix as a contributor in incident development at port approaches?
Q 4 Do you see the VTSO communication pre-fix as a contributor in incident development at port approaches?
Q 5 Do you think a VTSO should be held accountable if an accident takes place?

Source: Author,2011

The above table shows analysis to research questionnaire answers received from ships' masters.

Appendix I.06: Chief officers' response analysis table

Chief (C)											Total	5
Qst / Rank		Answers		Age Group			Regions					
			Y	A (23 - 26)	B (27 - 35)	C (35 +)	FE	ME	EU	A	ISC	others
		No. of Participents										
Q 1	a	Busy VHF Com. Channel										
	b	Lack of VTS area Info.										
	c	Local Shipping traffic density										
	d	VTSO English ability										
	e	Ship's staff VTS awareness /expectation										
	f	VTS ship's awarness / expectations										
	g	master / officer area experience										
Q2	a	Vessel traking/moitering and warning										
	b	Number of incidents and near misses										
	c	risk analysis for VTS area										
	d	avilability of standard operation procedures										
Q3		response to question only										
Q4	a	Safety advices/information										
	b	traffic organisation instructions										
	c	navigational assistance										
Q5	a	Inside VTS area										
	b	Outside VTS area										

Q 1 What are the risk when approaching port area (P.Stn) from sea?
Q 2 What would be factors to evalute the performance of a VTS centre?
Q 3 Do you see the VTSO communication pre-fix as a contributor in incident development at port approaches?
Q 4 Do you see the VTSO communication pre-fix as a contributor in incident development at port approaches?
Q 5 Do you think a VTSO should be held accountable if an accident takes place?

Source: Author,2011

Appendix I.07: Second officers' response analysis table

Second (S)												Total	2
Qst / Rank		Answers		Age Group			Regions						
			Y	A (23 - 26)	B (27 - 35)	C (35 +)	FE	ME	EU	A	ISC	others	
		No. of Participents											
Q 1	a	Busy VHF Com. Channel											
	b	Lack of VTS area Info.											
	c	Local Shipping traffic density											
	d	VTSO English ability											
	e	Ship's staff VTS awareness /expectation											
	f	VTS ship's awarness / expectations											
	g	master / officer area experience											
Q2	a	Vessel traking/moitering and warning											
	b	Number of incidents and near misses											
	c	risk analysis for VTS area											
	d	avilability of standard operation procedures											
Q3		response to question only											
Q4	a	Safety advices/information											
	b	traffic organisation instructions											
	c	navigational assistance											
Q5	a	Inside VTS area											
	b	Outside VTS area											

Q 1 What are the risk when approaching port area (P.Stn) from sea?
Q 2 What would be factors to evalute the performance of a VTS centre?
Q 3 Do you see the VTSO communication pre-fix as a contributor in incident development at port approaches?
Q 4 Do you see the VTSO communication pre-fix as a contributor in incident development at port approaches?
Q 5 Do you think a VTSO should be held accountable if an accident takes place?

Source: Author,2011

Appendix I.08: Third officers' response analysis table

Third (T)												Total	3
Qst / Rank		Answers		Age Group			Regions						
			Y	A (23 - 26)	B (27 - 35)	C (35 +)	FE	ME	EU	A	ISC	others
		No. of Participents										
Q 1	a	Busy VHF Com. Channel										
	b	Lack of VTS area Info.										
	c	Local Shipping traffic density										
	d	VTSO English ability										
	e	Ship's staff VTS awareness /expectation										
	f	VTS ship's awarness / expectations										
	g	master / officer area experience										
Q2	a	Vessel traking/moitering and warning										
	b	Number of incidents and near misses										
	c	risk analysis for VTS area										
	d	avilability of standard operation procedures										
Q3		response to question only										
Q4	a	Safety advices/information										
	b	traffic organisation instructions										
	c	navigational assistance										
Q5	a	Inside VTS area										
	b	Outside VTS area										

Q 1 What are the risk when approaching port area (P.Stn) from sea?
Q 2 What would be factors to evalute the performance of a VTS centre?
Q 3 Do you see the VTSO communication pre-fix as a contributor in incident development at port approaches?
Q 4 Do you see the VTSO communication pre-fix as a contributor in incident development at port approaches?
Q 5 Do you think a VTSO should be held accountable if an accident takes place?

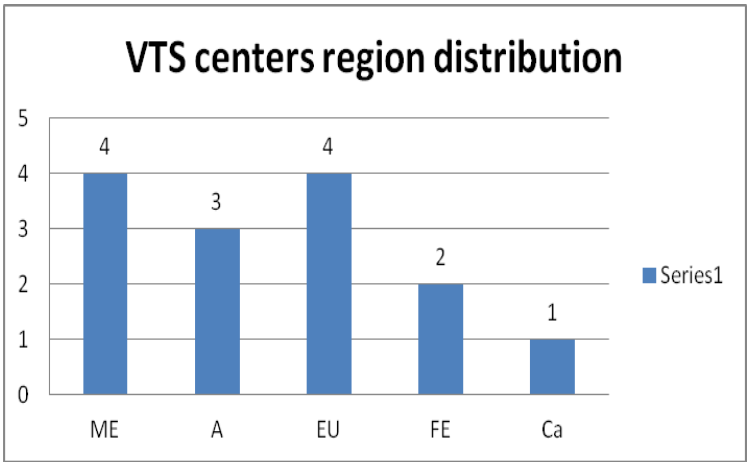
Source: Author,2011

Appendix J: Summary table of VTS centers' answer to questionnaire

Other findings

Summary of VTS centers / Competent Authorities

Region	ME	A	EU	FE	Ca		Sum	Remarks
No. Participants								
No. of available VTS								
No. of Regulated VTS								
Training Requirements								*Availability of National regulation for VTS activities*
Licensing of VTSO								
VTS Responsibilities								
Measures of KPI								
Bench Mark VTS								
Public management								*Responsibility of VTS Operation*
Private management								
Published at National level								*Announcement Of VTS Centers at*
The IMO								

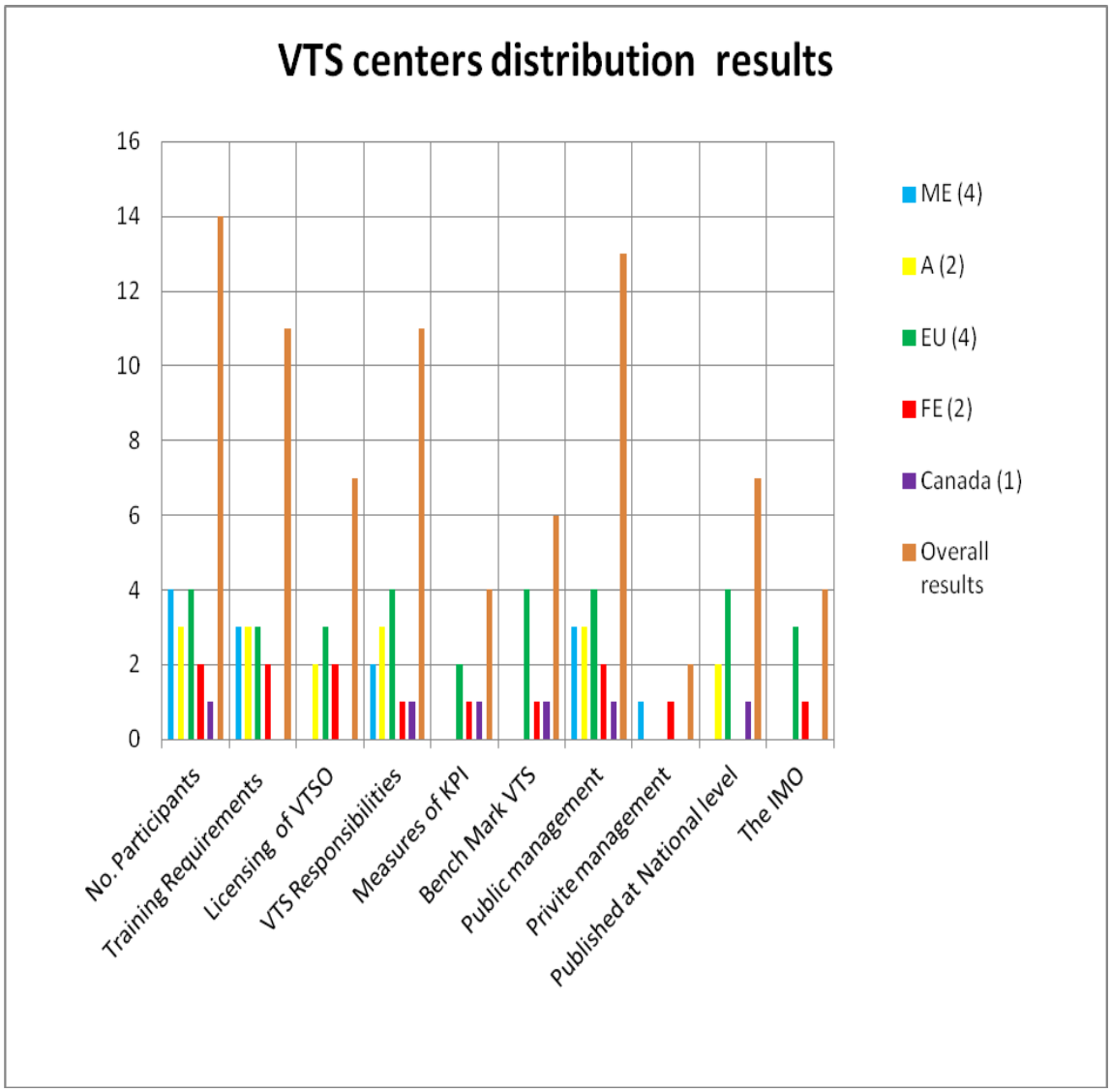


ME ; Kuwait, Bahrain, UAE, Qatar.
A; Kenya, Nigeria, Benin
EU; Norway, Denmark, Sweden, Rotterdam,
FE; Hong Kong, Malysia
C; Canada

Source: Author, 2011

For the purpose of this research, regions have been identified as given in the table above, the researcher is aware that there is another "Geographical region and composition" as defined by the UN, found at http://unstats.un.org/unsd/methods/m49/m49regin.htm .

Appendix J.01: VTS centers' questionnaire result distribution chart



Source: Author, 2011

Appendix K: VTS centers' questionnaire feedback compilation table

VTS centre / Competent Authority / Maritime Administartion feedback																			
Q 1	How VTS centres do you have? And what type are they?																		
Item / Particpents		1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	14
Region																			
a	No. of VTS																		0
b	Type of VTS or LPS																		0
Q 2	Do regulation exist in your national law regarding VTS centres, VTS personals ashighlighted below and VTS area?																		
Item / Particpents		1	2	3	4	5	6	7	8	9	10	11	12	13	14				
a	Training requirments																		0
b	Licensing of VTSO																		0
c	VTS responsibilities / obligation																		0
d	Measures (KPI) to evaluate VTS																		0
Others																			
*																			
Q 3	How do you benchmark (KPI) the quality of your VTS/																		
Item / Particpents		1	2	3	4	5	6	7	8	9	10	11	12	13	14				
response to question only Txt																			0
Q 4	Who is responsible for VTS operation?																		
Item / Particpents		1	2	3	4	5	6	7	8	9	10	11	12	13					
a	Public sector (CG, Port authority,etc)																		0
b	Privite Sector (port operator / oil terminal,etc																		0
Q 5	Are all VTS centres published at																		
Item / Particpents		1	2	3	4	5	6	7	8	9	10	11	12	13	14				
a	National level (within the law / reg)																		0
b	the IMO																		0
			Yes	1			No	0											

Source: Author, 2011