The subject, not just an object
Maritime Safety in the Vessel Traffic Service Domain

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Abstract

Although the term maritime safety is widely used in the maritime domain, there is no exact definition of what is included in it. This thesis is an explorative study with focus on the Vessel Traffic Service domain. VTS operators were interviewed and observed to gain insights in how maritime safety is constructed from the perspective of an operator. Further, definitions of maritime safety by central organizations in the maritime domain have been studied through a literature study and several interviews.

The results of the study indicate that there is no common definition of the term maritime safety. The organizations generally identify maritime safety as an overall goal or an umbrella term for measures such as traffic separation schemes or fairway design etc. In contrast to this, the analysis of the data obtained indicates that VTS operators define maritime safety as a context-dependent condition which is shaped by their own action.

It is concluded that there is a gap between the central actors’ and the VTS operators’ understanding and definition of maritime safety. To increase the overall safety in the maritime domain, there is the need to overcome this gap through constructing common values, norms and identities. Instead of having several definitions of maritime safety, there should be one definition which can capture the fact of safety being a dynamic condition which is shaped by the enactment of reliability through, in this case, the VTS operators.

Finally, the VTS as service to the maritime community should be seen as the subject in the construction and promotion of maritime safety, not as just an object.
Acknowledgement

Although my name is on the cover of this thesis, it is a well-known secret that a thesis never is the work of just one person. Without the support, guidance, help and criticism of several people, this thesis would not have been written at all. Therefore, I would like to thank some of those people in specific.

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Linköping, October 2009

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### Table of Contents

1 Introduction .......................................................................................................................... 1
   1.1 General introduction ......................................................................................................... 1
   1.2 Background ...................................................................................................................... 1
   1.3 Aim .................................................................................................................................. 8
   1.4 Research question ............................................................................................................ 8
   1.5 Outline and limitation of this study ................................................................................ 9

2 Theoretical Framework .......................................................................................................... 10
   2.1 Organizations, accident analysis and safety ..................................................................... 10
   2.2 Perrow (1984): Normal Accidents Theory ...................................................................... 10
   2.3 Pidgeon & O’Leary (2000): Man-made disaster ............................................................... 12
   2.4 High Reliability Organisations (HRO) .......................................................................... 12
   2.5 The VTS as a HRO ......................................................................................................... 15

3 Method .................................................................................................................................. 18
   3.1 General description .......................................................................................................... 18
   3.2 Literature study ............................................................................................................... 19
   3.3 Interviews ...................................................................................................................... 19
   3.4 Observation ..................................................................................................................... 20
   3.5 Analysis of the collected data ........................................................................................ 21

4 Results .................................................................................................................................. 23
   4.1 Maritime Safety – an overview of the international actors’ perspective ......................... 23
   4.2 Interviews ...................................................................................................................... 24
   4.3 Observation ..................................................................................................................... 29

5 Analysis .................................................................................................................................. 35
   5.1 How do the various actors in the maritime domain define maritime safety and what do
       these definitions have in common? .................................................................................... 35
   5.2 How does the work of a VTS operator relate to the actors’ definitions of maritime safety? 37
   5.3 How do the VTS operators define maritime safety? ......................................................... 38
   5.4 How do VTS operators promote maritime safety? .......................................................... 39

6 Discussion .............................................................................................................................. 42
   6.1 General discussion .......................................................................................................... 42
   6.2 Theoretical framework ................................................................................................... 43
   6.3 Methodology ................................................................................................................... 43
   6.4 Results .............................................................................................................................. 48
6.5 Further research ......................................................................................................... 48
7 Conclusions .................................................................................................................. 50
  7.1 General conclusions ................................................................................................. 50
8 References ................................................................................................................... 51
Appendix A ....................................................................................................................... 53
Appendix B ....................................................................................................................... 54
Appendix C ....................................................................................................................... 55
Abbreviations/Definitions

AIS
Automatic Identification System, a system that transmits certain information about the ship (name, position, speed etc.) and receives the same information from other AIS-equipped vessels in the vicinity.

ANM
Aids to Navigation Management (IALA committee).

AtoNs
Aids to Navigation.

CCTV
Closed-circuit television, the transmission of signals from video cameras to a specific place (as opposed to broadcast television).

COLREGS
International Regulations for Preventing Collisions at Sea. The IMO “rules of the road”, to be followed by vessels at sea.

EEP
Engineering, Environmental and Preservation (IALA committee).

EMSA
European Maritime Safety Agency, the maritime safety agency of the European Union.

e-NAV
E-Navigation (IALA committee).

ETA
Estimated Time of Arrival, a measure of when a vessel is estimated to arrive at a certain point.

Fairway
Fairway in the widest sense of the term refers to the water areas used for shipping. It is however normally used in the sense of a cleared channel intended for navigation.

HELCOM
Helsinki Commission, intergovernmental cooperation of the European Community and countries around the Baltic Sea to protect the marine environment from all kinds of pollution.

HRO
High Reliability Organisation.

IALA
International Association of Marine Aids to Navigation and Lighthouse Authorities.

ICS
International Chamber of Shipping.

IHO
International Hydrographic Organization.

IMO
International Maritime Organization.

ISPS

ITU
International Telecommunication Union.

JRCC
Joint Coordination Centre responsible for all search and rescue operations associated with aeronautical and maritime emergencies in Denmark.
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<thead>
<tr>
<th>Acronym</th>
<th>Definition</th>
</tr>
</thead>
<tbody>
<tr>
<td>LAP</td>
<td>Legal Advisory Panel (IALA committee)</td>
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<tr>
<td>MARPOL</td>
<td>The International Convention for the Prevention of Pollution from Ships</td>
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<tr>
<td>MRCC</td>
<td>Maritime Rescue Coordination Centre responsible for all search and rescue operations at sea in Sweden</td>
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<td>PAF</td>
<td>Pilot Authority Forum (IALA committee)</td>
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<td>Paris MoU</td>
<td>The Paris Memorandum of Understanding on Port State Control</td>
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<td>RADAR</td>
<td>Radio detection and ranging, an object detection system</td>
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<td>SMA</td>
<td>The Swedish Maritime Administration</td>
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<td>SMCP</td>
<td>Standard Marine Communication Phrases used to facilitate communication in the shipping domain</td>
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<td>SOLAS</td>
<td>International Convention for the Safety of Life at Sea. IMO regulations concerning the safe construction and equipment of ships</td>
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<td>SRS</td>
<td>Ship Reporting System, a voluntary or mandatory reporting system for vessels in a specified area. It collects and distributes information of importance for the vessel traffic safety</td>
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<td>SSA</td>
<td>Swedish Shipowners’ Association</td>
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<td>SSN</td>
<td>SafeSeaNet, a European platform for maritime data exchange</td>
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<td>STA</td>
<td>Swedish Transport Agency</td>
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<tr>
<td>STCW</td>
<td>International Convention of Standards of Training, Certificate and Watchkeeping; IMO regulations concerning the training and certification for personnel on seagoing merchant ships</td>
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<td>TOS</td>
<td>Traffic organisation service offered by a Vessel Traffic Service</td>
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<td>TSS</td>
<td>Traffic Separation Scheme</td>
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<tr>
<td>VHF</td>
<td>Very high frequency, a band of radio frequencies used for among other things maritime communication</td>
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<tr>
<td>VTS</td>
<td>Vessel Traffic Service, a shore-side service for vessel monitoring, navigational assistance and information service</td>
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1 Introduction

The following chapter introduces the reader to the study and its context in the research domain as such. Further, the aim, the research questions, the limitations and the outline of this study are presented.

1.1 General introduction

On July 14th 2009 the Italian oil tanker “Maria M” grounded near Donsö in the southern archipelago outside of Gothenburg. No one was harmed and there was no oil spill. The grounding was identified to be caused by a failure of the AIS-system onboard of the vessel. Although the vessel was heading towards a grounding, the VTS operator did not take any actions (Göteborgs-Posten, 2009).

But could the operator really have had an impact on the situation? Could the grounding have been prevented? These are typical questions that arise whenever a grounding or an accident happens in an VTS area. In the case describe above, the vessel did not actually pass the reporting line and was therefore outside of the area the VTS Gothenburg is responsible for. So should the operator be blamed at all?

In the past 25 years several methods to analyze accidents have been developed. Mainly because of the catastrophic outcome of accidents such as Chernobyl or Bophal, the general public has become concerned with and aware of different industries working with hazardous technology and the possibly fatal consequences in case of an accident (La Porte, 1996).

In the shipping domain there are only few studies focusing on shore-based services provided to enhance the safety of the maritime community. Most of the research in the area of shore-based services in this domain has focused on technology development (e.g. Chang, 2004; Høye, Eriksen, Meland & Narhem, 2008; Schreek & Aliferis, 1998, Kharchenko & Vasylyev, 2004). Common is also the identification of the human element or human error as the root of accidents in the shipping domain (e.g. Zachau, 2008; Schager, 2008). However, this thesis is trying to refrain from this perspective. Accidents are seen as complex phenomena which can not arise out of one single factor, but rather may have multiple causes (Hollnagel, 2006).

The public awareness for accidents in the shipping domain and their possibly fatal consequences arose after several oil spills in the 1970s. As consequence, a shore-based service in the maritime sector was implemented, the Vessel Traffic Service (IALA, 2008). Vessel Traffic Service (VTS) is a shore-side service implemented by a “Competent Authority to improve the safety and efficiency of vessel traffic and to protect the environment” (“Guidelines for Vessel Traffic Services,” 1997). The VTS operates through VTS centres with operators monitoring traffic, assisting in navigational matters and providing information to the maritime community in a specific area (“Guidelines for Vessel Traffic Services,” 1997).

1.2 Background

This part of this chapter will introduce the Vessel Traffic Service domain and organizations in the maritime domain which have an impact on safety.

1.2.1 VTS - a shore-side service to the maritime community

In this section the VTS as shore-side service is going to be described in detail.
1.2.1.1 Definition

The Vessel Traffic service is a shore-side service “implemented by a Competent Authority, designed to improve the safety of vessel traffic and to protect the environment” (“Guidelines for Vessel Traffic Services,” 1997). Benefits of the implementation of a VTS are the possibility to monitor and identify vessels, to strategically plan vessel movements and to assist a vessel by providing navigational information and assistance to all vessels in a VTS area (“Guidelines for Vessel Traffic Services,” 1997).

A VTS is operated by highly skilled operators in a VTS centre. The operators monitor the traffic, assist in navigational matters and provide information for the vessels in the defined VTS area as well as to other actors in the maritime community such as Customs, shipping agencies, pilots, lock masters etc.

The main objective, according to the IMO Resolution on Vessel Traffic Services, is to “improve the safety and efficiency of navigation, safety of life at sea and the protection of the marine environment” (“Guidelines for Vessel Traffic Services,” 1997).

1.2.1.2 The history of the VTS

Shipping has always been a major mean of transportation and commerce. After World War II limitations of the traffic management concerning the utilization of port facilities were addressed. Especially during bad visibility conditions, vessels were delayed and port operations, such as storage of goods, disrupted. To minimize these disruptions shore-based radar chains for traffic monitoring were implemented to keep the traffic flowing in the port areas. The first radar chain was implemented in Douglas, Isle of Man, in 1948, but other major ports in northern Europe followed soon after, e.g. Amsterdam (Ymuiden) in 1952, Rotterdam in 1956 (IALA, 2008).

Due to several major oil spills in the 1970s, the public awareness for accidents in the maritime sector increased. It was followed by the need for harmonization and cooperation among the radar chain operators and other actors such as pilots. Slowly VTS as a shore-based service developed and in 1985 the Inter-Governmental Maritime Consultative Organization (IMCO), later IMO, adopted the resolution A.857, Guidelines for Vessel Traffic Services. This resolution was superseded in 1997 by the IMO Assembly Resolution on VTS A.857 (20) (IALA, 2008).

There are two categories of VTS; coastal services and port or river services. Coastal services are implemented to assist a vessel’s passage through coastal waters, especially in areas with high traffic density, areas which have a particularly sensitive environment or areas which are difficult to navigate in due to geographical conditions. Port or river services assist the efficiency and safety of navigation when entering or leaving a port or harbour or when sailing on rivers in areas, where the manoeuvring of vessels is restricted. Nowadays there are more than 500 operational services worldwide (IALA, 2008).

1.2.1.3 VTS today

As mentioned above, VTS is a shore-side service to assist, monitor and organize the maritime traffic implemented by a Competent Authority. A Competent Authority is defined by the IMO as “the authority made responsible, in whole or in part, by the Government for vessel traffic safety, including environmental safety, and the protection of the environment in the area”. There are three different types of shore-based services connected to VTS; information service, navigational assistance (NAS) and traffic organization (TOS) (IALA, 2008).
Information service is offered to ensure that all essential information is available to all vessels in the VTS area in good time. The information can concern positions, intentions and destinations of vessels, boundaries, procedures, radio channels, reporting points etc. regarding the VTS area and variables influencing the navigation and manoeuvrability of a ship such as status of aids to navigation, traffic congestions, meteorological information etc. (IALA, 2008)

Navigational assistance service (NAS) assists the navigational decision making process on board a vessel and monitors the effects of it. Further, NAS consists of two different parts, navigational information and navigational advice. Navigational information may contain course and speed made by a vessel, warnings to specific vessels and positions of other traffic as well as positions relative to fairway axis and way-points. Navigational advice is an active participation in the on board navigational decision making of a ship. It is up to the Competent Authority to decide whether and under which circumstances the VTS can and may assist the navigational decision making of vessels in the VTS area (IALA, 2008). However, IMO states that in case of navigational assistance, the instructions given to vessels should be result-oriented leaving all details of execution to the master or pilot on board the vessel ("Guidelines for Vessel Traffic Services," 1997). An example for navigational advice is shore-based pilotage as conducted in the Netherlands. When the weather conditions are too bad for pilots to board a vessel, there is the possibility of shore-based pilotage. The shore-based pilot is located at a station in the VTS centre and gives result-oriented advice to vessels in the approach to the harbour entrance (Lützhöft, Praetorius, Bruno & Brödje, 2009).

Traffic Organization Service (TOS) is a service intending to prevent the upcoming of dangerous situations. It has further the objective to keep the traffic movement safe and efficient within the VTS area. Traffic organization is concerned with the forward planning of the traffic, especially in the case of congestions or when special transports may affect the surrounding traffic. Monitoring the traffic and establishing compliance to the prevailing rules in the area are a part of this service. Further, VTS sailing plans are an important part of the traffic organization. A sailing plan summarizes all important information for traffic organization such as estimated time of arrival (ETA) in the VTS area or the departure from berth or anchorage area (IALA, 2008).

Aside from VTS, there are also Ship Reporting Systems (SRS). Ship Reporting Systems, as well as VTS, contribute to the safety of life at sea as well as to the safety and efficiency of navigation and the protection of the marine environment ("International Convention for the Safety of Life at Sea," 1974). Ship reporting systems are used to "provide, gather or exchange information through radio reports" ("General Principles for Ship Reporting Systems and Ship Reporting Requirements, including Guidelines for Reporting Incidents involving Dangerous Goods, Harmful Substances and/or Marine Pollutants," 1997).

The main difference between VTS and SRS mainly is that a VTS cannot be established in international waters (Hughes, 2009). Further, SRSs are responsible for providing, gathering and exchanging information, they do not take any responsibilities in form of traffic organization or navigation assistance service, although the traffic might be regulated passively by traffic separation schemes (TSS) in some areas with a mandatory SRS. Additionally, a VTS can both be port and coastal while a SRS is always coastal (Hughes, 2009).

It is important to differentiate between SRS and VTS as there is a tendency to operate reporting systems from VTS centres. In some areas a reporting system is even called VTS, e.g. SOUND VTS
which is the reporting system for the Sound. This leads to a problem in the maritime community to see the clear difference between those two services. A SRS only gathers, exchanges and provides information while a VTS can be responsible for traffic organization and navigational assistance (Hughes, 2009).

1.2.1.4 VTS personnel
The standards for the education of VTS personnel are set by the recommendation V-103 which was adopted in 1998. The recommendation has the objectives to provide basic standards and guidelines for VTS training programmes and the recruitment of potential operators. It also helps to ensure that the certified staff is able and qualified to act as VTS operator and to provide model courses for the education of VTS personnel ("IALA Recommendation V-103 on Standards for Training and Certification of VTS Personnel," 1998).

A VTS operator is a highly skilled person providing services to the maritime community in a specific area or sector in an area. Most of the VTS Operators have prior marine experience and at some VTS centres it is even mandatory to have a background as a master mariner (Lützhöft et al., 2009). After the completion of the basic training course, the future operator is trained by a fellow operator in a specific VTS centre. This “On-the-Job training” is conducted by a certified operator and is supposed to teach the new operator how the traffic in the VTS area is handled and what the appropriate actions are (IALA, 2008).

Aside from job descriptions concerning VTS operators, there are descriptions for VTS supervisors and VTS managers stated in the IALA recommendation (1998). VTS supervisors co-ordinate, advise and oversee the actions of a VTS operator. A VTS manager is part of the management infrastructure and keeps in contact with adjacent organizations such as port authorities. Depending on the size of a VTS area the Competent Authority can decide on the number of operators, supervisors and managers (IALA, 2008).

1.2.2 Actors in the maritime community
This thesis is going to investigate the definitions of maritime safety in the maritime community to be able to compare the various organisations’ understanding of this concept with the actual work performed at VTS centres. This part of the thesis introduces several important actors in the maritime sector which either have a direct or indirect influence on the VTS and its work as well as on the services offered by the VTS.

The following actors are going to be presented briefly:

- International Maritime Organization (IMO)
- International Association of Marine Aids to Navigation and Lighthouse Authorities (IALA)
- European Maritime Safety Agency (EMSA)
- Classification Societies
- Swedish Transport Agency (STA)
- Swedish Maritime Administration (SMA)
- Swedish Shipowners’ Association (SSA)
1.2.2.1 International Maritime Organization

The International Maritime Organization (IMO) is a United Nations agency concerned with the safety and security of shipping as well as pollution prevention of the marine environment. The organization was established through a convention in 1948 and the first meeting took place in 1959. IMO was originally called Inter-Governmental Maritime Consultative Organization, but changed its name in 1982 to International Maritime Organization (International Maritime Organization, 2009).

From the beginning, the main task of the IMO was to develop and maintain a regulatory framework for shipping. Nowadays topics such as safety, environmental concerns, legal matters, technical cooperation between Member States, maritime security and the efficiency of shipping are also objectives of the organization. Today the IMO has 168 Member States. Its headquarters is located in London. The technical work is carried out in committees with sub-committees. There are five committees: Maritime Safety, Marine Environment Protection, Legal, Technical Co-operation, Facilitation (International Maritime Organization, 2009).

Up to today, the IMO has generated 47 treaty instruments completed by a large number of protocols, recommendations, guidelines etc. Among the most important treaties are SOLAS (International Convention of the Safety of life at Sea, 1974), MARPOL (International Convention for Prevention of Pollution from ships, 1978) and STCW (International Convention on Standards of Training, Certification and Watchkeeping for Seafarers, 1978) (International Maritime Organization, 2009).

1.2.2.2 International Association of Marine Aids to Navigation and Lighthouse Authorities (IALA)

The International Association of Marine Aids to Navigation and Lighthouse Authorities (IALA) is a non-profit and non-governmental technical association concerned with the harmonization of Aids to Navigation (AtoNs) to ensure safe and efficient vessel movement while protecting the marine environment. IALA was founded in 1957 and consists of members representing AtoNs authorities, manufacturers and consultants and has since its establishment contributed to accident reduction and increased safety of life and property at sea while protecting the environment (International Association of Marine Aids to Navigation and Lighthouse Authorities, 2009).

The technical work of IALA is conducted through committees and working groups who study topics of interest, e.g. e-Navigation. Today there are six different committees working: e-Nav (e-Navigation), ANM (Aids to Navigation Management), EEP (Engineering, Environmental and Preservation), VTS (Vessel Traffic Services), PAF (Pilot Authority Forum) and LAP (Legal Advisory Panel). The various committees are composed of experts from IALA’s members. There are three kinds of membership; national (applies to any National Authority of a country), associate (services, organizations or scientific agencies) and industrial (manufacturers and distributors of marine aids) membership (International Association of Marine Aids to Navigation and Lighthouse Authorities, 2009).

IALA as an organization publishes guidelines, handbooks and recommendations which are regularly updated. All work tries to take the needs of the mariners, the technological development and requirements and constraints of AtoNs into account (International Association of Marine Aids to Navigation and Lighthouse Authorities, 2009).
In the area of VTS the IALA has for example stated a recommendation concerning the education of VTS operators, supervisors and managers ("IALA Recommendation V-103 on Standards for Training and Certification of VTS Personnel," 1998).

1.2.2.3 European Maritime Safety Agency (EMSA)


The agency acts as scientific and technical assistance to the European Commission in the field of maritime safety and prevention of pollution by ships. It is assisting the Commission in establishing Community legislation in the maritime sector by monitoring the implementation and evaluating the effectiveness of measures initiated.

The key areas of work for EMSA are:

- Strengthening of the Port State control regime
- Auditing of Community-recognized classification societies, e.g. Lloyd’s Register
- Development of a common methodology to investigate maritime accidents
- Establishment of the Community vessel traffic monitoring and information system SafeSeaNet (SSN)

The agency’s main goals are to reduce the risk of maritime accidents, marine pollution from ships and the loss of human life at sea (European Maritime Safety Agency, 2009). One of the projects already established to enhance the safety of navigation on European waters is the so-called SafeSeaNet (SSN), a traffic monitoring and information hub where information from Member States is connected through links.

1.2.2.4 Classification societies

Classification societies are the organizations that set up rules concerning the standard of the technical equipment in relation to design and construction of vessels and offshore installations. These rules are published by the classification society and all vessels, part of such a society, have to comply with the standard (International Association of Classification Societies, 2006). Today there are more than 50 classification societies worldwide of which 13 are recognized officially by the European Maritime Safety Agency (European Maritime Safety Agency, 2009).

Classification societies have been recognized by the IMO since the late 1960s. Their work is based on rules which are established to develop and assess the structural integrity as well as the functioning of the systems on board a vessel. If a vessel complies with a society’s classification rules, it can apply for a membership (International Association of Classification Societies, 2006).

As member of a classification society a vessel is surveyed regularly to make sure that it complies and continues to comply with the classification rules. A survey consists of several examinations in which it is made sure that there is no major corrosion or damage. If there is any defect found during the inspection, the society is going to utter recommendations and measures that need to be fulfilled.
no improvements are made, the vessel runs the risk of losing its class (International Association of Classification Societies, 2006).

Ten of the most important classification societies are part of the International Association of Classification Societies LTD. They represent 94% of all class registered vessels in the maritime sector. An example of a well-known classification society is Lloyd’s Register (European Maritime Safety Agency, 2009)

1.2.2.5 Swedish Transport Agency (STA)
The Swedish Transport Agency (STA) was established in January 2009. Its aims to work for accessibility, quality and sustainability of the rail, air, sea and road transport in Sweden. The agency has the overall responsibility to state regulations for the traffic and ensures that these are followed (Swedish Transport Agency, 2009).

As the agency is responsible for the traffic in general, it works based on different departments. There are six departments: Railway Department, Civil Aviation Department, Maritime Department, Traffic Registry Department, Road Traffic Department and Development Department (Swedish Transport Agency, 2009).

The STA influences the maritime community through the work of the Maritime Department. Its objectives are the formulation of regulations, the examination and granting of permits and the overall supervision of all vessels, both Swedish and foreign, in the Swedish territorial waters. Further, it also works for improving the maritime safety and environmental influences of the recreational boating, e.g. for leisure craft in the archipelagos outside Stockholm and Gothenburg (Swedish Transport Agency, 2009).

Additionally, the Swedish Transport Agencies analyzes maritime accidents and near-misses. The reports are published in form of Accident Investigation Reports on the agency’s homepage. The aim of the analyses is to understand why a certain accident has happened and to prevent it from happening in the future (Swedish Transport Agency, 2009).

Before January 2009 the objectives covered by the maritime department of the Swedish Transport Agency were part of the work of the Swedish Maritime Administration.

1.2.2.6 Swedish Maritime Administration (SMA)
"The Swedish Maritime Administration shall work towards creating favourable conditions for shipping in Sweden and for Swedish shipping". (Swedish Maritime Administration, 2009)

The Swedish Maritime Administration is a public enterprise within the transport sector. It works to keep sea lanes open and safe for the maritime traffic. As part of this, SMA offers pilotage, fairway operation, maintenance and supervision, icebreaking, maritime and aeronautical search and rescue (Swedish Maritime Administration, 2009).

As a primary task the SMA is responsible for providing infrastructural services concerning the accessibility and safety of the fairways to meet the needs of the shipping industry. Further, SMA is also responsible for maritime search and rescue services, for crises management planning, for the co-ordination of maritime geographic information and for the promotion of a sustainable development of shipping. Additionally, responsibilities also include monitoring the development of the Swedish
shipping industry and for the provision of information and advice regarding the safety of leisure craft (Swedish Maritime Administration, 2009).

1.2.2.7 Swedish Shipowners’ Association (SSA)
The Swedish Shipowners’ Association is a trade organization for the Swedish shipping industry. It represents Swedish ship-owners who are active all over the world. The association’s main objective is to work for better conditions in the international shipping business and to raise maritime safety issues. Further, it works actively in the field of environmental issues, e.g. more effective and cleaner fuel (Swedish Shipowners’ Association, 2009).

As a trade organization, the SSA works closely together with Swedish governmental as well as other international organizations such as the IMO. Essential policy documents are published in both Swedish and English (Swedish Shipowners’ Association, 2009).

1.3 Aim
This thesis aims to analyze the Vessel Traffic Service as an organization based on the High Reliability Organization (HRO) perspective (e.g. Roberts, 1990) to provide insights on the VTS and its work as well as on how safety is constructed in this specific domain. As the term “maritime safety” is often used when describing the goal of different safety measures in the maritime sector, the overall goal of this thesis is to derive implications on how different actors define this concept and how these definitions relate to the daily work of VTS operators. What does an operator do to promote maritime safety and how does he himself define this concept? Does the perception of the work to promote safety differ between VTS centres or does it even differ from person to person?

This study focuses on the VTS as an organization offering shore-based services to the maritime community, constituted to enhance maritime safety and the sustainable use of the oceans today and in the future (International Maritime Organization, 2009). Up to now, most scientific research in the VTS domain has been conducted as quantitative studies concerned with concepts such as workload, situation awareness and performance (e.g. Wiersma & Mastenbroek, 1998; Hoffman, Riley & Dion, 1998). These studies have mainly had an impact on the technological development of decision support systems in the VTS domain. However, a qualitative study of the VTS as a high reliability organization could improve the overall understanding for how the VTS operates and what can be done to improve the mutual understanding of different actors in this domain. Therefore this study is taking a qualitative approach by using different ethnographic methods (interviews and observations) for data gathering.

1.4 Research question
The following research questions guided the work for this thesis:

1. How do the various actors in the maritime domain define maritime safety and what do these definitions have in common?
2. How does the work of a VTS operator relate to the actors’ definitions of maritime safety?
3. How do VTS operators define maritime safety?
4. How do VTS operators promote maritime safety?
1.5 Outline and limitation of this study
This thesis presents the outcome of a qualitative study conducted in the VTS domain. Although it is recognized that there are differences between a Ship Reporting System and a Vessel Traffic Service, the two services are both treated as VTS in this report. This is due to the fact that some of the operators who participated in this study worked at the Sound VTS. Officially Sound VTS is a reporting system, but it is also operated by VTS operators.

Further, all operators that participated in this study were men. Therefore “he” is used in connection with describing a VTS operator’s actions. However, this is does not mean that there are not any female VTS operators; it does simply indicate that there were no female operators available during the time the data for this thesis was collected.

This thesis presents the study in 7 chapters. Chapter 1 gives a general introduction to the topic and outlines the background of the study. The Vessel Traffic Service and its scope are explained as well as several central actors in the maritime domain are introduced. Chapter 2 sets up the theoretical framework which is used for analyzing the collected data. In chapter 3 all methods used to obtain data are shown and explained. The results of the study are presented in chapter 4. Chapter 5 connects the collected data with the theoretical framework. The research questions are answered by analyzing the data with concepts derived from high reliability organization (HRO) theory. Chapter 6 discusses the theoretical framework, the methodology used and the overall results of this study. The chapter also makes suggestions for future research. The final conclusions are presented in chapter 7. Interview and observation guides can be found in the Appendix.
2 Theoretical Framework

The following chapter introduces the theoretical framework of this thesis and outlines the VTS as a High Reliability Organization (HRO).

2.1 Organizations, accident analysis and safety

After the Chernobyl catastrophe accidents, incidents and safety became popular research topics focused on understanding how and why accidents occur and how this knowledge can be used to improve the safety of a system. Since the late 1980s several theories have addressed these topics and cover various aspects of risk and safety (e.g. Hollnagel & Woods, 2005; Leveson, Dulac, Marais & Carroll, 2009).

“Safety is the sum of the accidents that do not occur” (Hollnagel, 2006, p.9)

This means whenever analyzing an organization’s safety, there is the need to take accidents and how and why they occur into concern. Through the past 20 years there has been a field of research called accident analysis in which the connection between safety, accident and incidents has been examined (e.g. Perrow, 1984).

This study aims to analyze the Vessel Traffic Service based on High Reliability Organization theory and to get insights on how safety is constructed in the VTS domain. The VTS is a complex system where operators interact with both other actors in the maritime community and advanced technical systems (Lützhöft, Praetorius, Bruno & Brödje, 2006). Therefore a systemic perspective on the objectives of this study has been taken. Accidents are seen as being systemic; they are non-linear phenomena that emerge in complex systems (Hollnagel, 2006). Linear models of the origin of accidents and failures are not being considered.

The three perspectives, normal accident theory (Perrow, 1984), man-made disaster (e.g. Pidgeon & O’Leary, 2000) and high reliability organizations (e.g. Roberts, 1990), presented in this chapter all take a systemic approach on the development of accidents as well as on safety being a property of the system.

2.2 Perrow (1984): Normal Accidents Theory

The following part of this chapter summarizes the essential ideas of Perrow’s (1984) work on normal accident theory.

Perrow’s (1984) theory on normal accidents was one of the first accident investigation models which addressed the complexity of high-risk industries. Perrow focuses on organizational accidents, such as Chernobyl or Challenger, which arise from multiple causes within complex modern technologies. These accidents are hard to foresee and predict as they arise out of the combination of latent and local conditions coupled with active failure on the sharp-end.

Active failures are individual errors and violations on the sharp end of the system. They are unsafe acts committed by an operator. Normally they have direct impact on the system’s safety and their consequences are immediate. In contrast to active failures, latent conditions are the underlying reason for the violation and error making of an operator. They are based on high-level decision making in the organization and they have an impact on all levels in the organization, shaping the local
work conditions of the operators. Further, latent conditions can be present in a system long before they combine with local conditions and active failure to an organizational accident (Perrow, 1984).

Complex systems normally have multiple layers of defence which are built up successively and mutually support each other, e.g. alarms, warnings, training, means for escape and rescue. Defences can either be hard (e.g. technical defences, physical barriers) or soft (e.g. procedures, rules, training, guidelines). The defences are constructed so that they can resist against single failures. Unfortunately, the more defences are constructed; the more complex the system gets for those who are supposed to manage and operate it (ibid).

To prevent organizational accidents from happening, the relationship between production and protection needs to be monitored closely. The absence of near-miss situation as well as accidents normally leads to the erosion of safety margins. Even measures introduced to enhance the protection can become measures to enhance the productivity. An example is the introduction of RADAR to the shipping domain. As RADAR was introduced, the safety margin of shipping increased. But soon it was noticed that the RADAR also allowed merchant vessels to travel at greater speed through crowded areas. The safety margin eroded (ibid).

As mentioned above, Perrow (1984) focuses on organizational accidents. These accidents are called system or normal accidents. A system is divided into four different layers: parts (smallest component in a system), units (functional relations of collection of parts), sub-systems (arrays of units) and the system as a whole. Normal accidents occur when there is a disruption of the outcome on the sub-system or system level. These accidents arise from the unintended and unanticipated interaction of multiple failures.

As systems grow, so does the number of functions they serve. Some parts of a system might even serve more than one function. As more components are added, even if they are meant to increase the safety, the complexity of the system grows, making it harder to oversee the possible interaction of all parts in the system. Out of this complexity, unintended and unanticipated interactions between independent sub-systems arise and are not recognized by the operators as “the information about the state of components or processes is more indirect and inferential in complex systems” (Perrow, 1984, p.83). As time proceeds, these unintended and unforeseen interactions can generate local failures which spread throughout the system and develop into a system accident (Leveson et al., 2009).

In summary, high-risk industries are complex systems in which the different components are tightly coupled. Out of the tight couplings unintended and unanticipated interactions arise which are normally not recognized by the operator as the information about the state of the components of the system is indirect and inferential due to the system’s complexity. Further, in combination with local conditions as well as latent conditions, an unrecognized failure can spread through the system and develop to an accident (Perrow, 1984).

Perrow’s model of natural accidents was one of the first accident analysis methods that took a systemic approach for analyzing accidents taking local and latent conditions into account while taking focus away from the human operator as the source of an accident.
2.3 Pidgeon & O’Leary (2000): Man-made disaster

Man-made disaster also takes a systemic approach on how accidents occur. But instead of emphasizing on an analysis in the light of concepts borrowed from the engineering disciplines, man-made disaster takes a sociological approach to organizational preconditions of disasters. From this perspective a disaster is a disruption or collapse of existing cultural norms and beliefs about hazard and danger in an organization. A disaster arises from the interaction between the human operator and the organizational settings of the socio-technical system while managing a complex ill-structured risk problem (Pidgeon & O’Leary, 2000).

As disasters arise from interactions, they are something that develops over time. The system’s vulnerability increases as failures and events occur unrecognized as the cultural norms and beliefs of the system are changing. The events build chains and the consequences are accumulated unnoticed. Pidgeon and Turner (1997) call this period of time disaster incubation period.

The man-made disaster approach considers safety as being a property of the system, not as anything individual. It is the level of shared-cognition and administrative structures that guide the notion of safety in an organization. Therefore safety culture can be defined as a set of assumptions and associated practices which lead to the construction of beliefs and norms about danger and safety.

In comparison with Perrow’s perspective on how accidents occur arising from latent failures, the man-made disaster perspective takes a sociological approach, looking for the underlying factors that started to change the cultural norms and beliefs concerning hazard and danger.

2.4 High Reliability Organisations (HRO)

Research in the area of High Reliability Organization was first conducted by the so-called Berkeley group in the late 1980s and 1990s. The work of the research group took Perrow’s theory of natural accidents as a baseline for their initial studies. In contrast to other research in the field of accident analysis and safety, HRO theory takes a new approach as it actively tries to find methods and measures to prevent accidents and to strengthen the safety culture in an organization (Rochlin, 1999).

A High Reliability Organization (HRO) is an organization which provides a service to the general public but is at the same time invisible to it. HROs are complex organizations which consist of several sub-systems/ groups in which highly skilled operators interact with advanced technology with tight couplings and strong interdependencies acting in an uncertain environment. Due to this an HRO needs to have a high degree of flexibility to be able to adjust its system performance. As an HRO is carrying out services to the public, major failures can have catastrophic consequences. Examples for HROs are e.g. hospitals or power plants (Roberts, 1990).

Due to their hazardous potential HROs are subject to political, economical and market constraints which regulate the organization’s and even the employees’ behaviour externally. These constraints arise from the fact that the failure of a HRO often has had greater negative social, environmental and economic impact than anticipated. There is a public anxiety about potential failures of a HRO. Therefore there is the continuous need for balancing organizational goals and missions with the avoidance of failures (La Porte, 1996).
HROs have also proven to be active in the sense that organizational responses are created with the intention to overcome intrinsic complex limitations of the technical operations and processes (La Porte, 1996). In this type of organization, the employees normally work with very complex technical systems which are inherently hazardous and demanding. The employees of an organization are therefore trained to cope with the complexity of the system while maintaining a high degree of safety. Leveson et al. (2009) identified the same behaviour as enactment of safety. Safety is created in HROs by workers who know the technical facts of the system and who are able to invent new actions and rules in order to maintain safety. This means that in a situation, which an employee identifies him-/herself as safety critical, he/she is likely to devise a course which will lead to a safer system state. This might for example be sending a warning message to other workers or turning off parts of system.

According to Leveson (2009), an organization is identified as being highly reliable when it has got a record of consistent safety, in the sense of non-occurrence of accidents and incidents, over a long period. Any complex organization dealing with hazardous technology can become a HRO and avoid system accidents, if appropriate behaviours and attitudes are created (Weick & Sutcliffe, 2007).

2.4.1 HRO characteristics

There are specific characteristics connected to High Reliability Organizations. The following part of this chapter is going to introduce several major characteristics used for the identification of the VTS as a HRO later in this study.

2.4.1.1 Reliability as Non-Event
Reliability is not a specific event; it is rather a condition which is dynamic and changing depending on the context. Problems are momentarily controlled by making compensating changes to one or more system components (Weick, 1987).

Further, as a non-event, reliability is invisible and cannot be observed because stable outputs are created by dynamic inputs. When the system output is constant, people easily get the notion that everything is normal and that there is nothing to pay attention to. Therefore employees in an organization might not always be conscious of the number and nature of mistakes they make in their daily work (Weick, 1987).

2.4.1.2 Culture and safety in HRO
In connection with safety and risk mitigation several researchers have focused on the organizational culture and its impact on safety in HROs (e.g. La Porte, 1996; Naevested, 2009; Weick, 1987; Rochlin, 1999).

While employees work with a large technical system, shared perceptions, norms and informal traditions may arise (La Porte, 1996) in an organizational culture. This culture can even include shared values and shared expectations. It helps the operators to build a cognitive infrastructure, a collective mindfulness. Collective mindfulness in organizations is based on what Weick and Sutcliff (2007) call a mindful infrastructure. If an organization is tracking small failures, resisting oversimplification, remaining sensitive to operations, maintaining the capability for resilience and taking advantage of the shifting locations of expertise in the organization itself, one can say that this organization is a HRO with a mindful infrastructure. This infrastructure will help the organization to
reduce the severity and frequency of unexpected events, to recover faster and learn from those events (Weick & Sutcliff, 2007).

Further, high reliability organizations show positive engagement in the construction of operational safety and seek to anticipate and to plan for unexpected events. But still, safety is more than just the opposite of risk. It is a positive state of a sub-system connected to human actions that are identified by operators themselves as safe. Therefore safety must be defined in organizational and social settings as something that arises out of human action and where the action itself becomes part of the system’s state of being safe (Rochlin, 1999).

To keep operations safe over time, the operators and manager in an organization need to continue to learn. Learning is essential to be able to adjust to the constantly changing settings. Safety is connected to values, identities and knowledge and those are mediated through reflexive and interactive learning between all levels in the organization (Rochlin, 1999).

As stated above, safety and culture in HROs are connected. Safety is an active state of a system which needs to be mediated through the different levels of an organization. This can only be achieved through a general commitment to certain values, norms, practices and expectancies that the members of the organization share. Further, learning needs to be part of the daily routine of the individuals as safe actions only can arise if knowledge and identities are mediated. In organizations such as power plants and air traffic control this mediation takes part through creation and modification of formal procedures (Rochlin, 1999).

2.4.1.3 Requisite Variety

The law of requisite variety was originally formulated by Ashby (1958) in the field of cybernetics in the mid 20th century. The law is concerned with control and regulation, and states that the variety of a controller should match the variety of the system to be controlled. The system is seen as a source of disturbance and the controller is supposed to keep the variety of the system’s output within certain limits. This can only be achieved if the variety of the controller is at least equal to the variety of the system (Hollnagel & Woods, 2005). In the domain of the VTS the controller is the VTS operator who is using the VTS system, a decision support system, to interact with the maritime traffic. In this thesis the variety of the controller is defined by the background of the operator. The background is identified by his education and experience both on shore and onboard.

According to Weick (1987), the law of requisite variety is important to HROs as they are working with complex technical systems. In such organizations requisite variety derives from communication in larger groups. It can be gained and lost in those groups. To match the variety of the technical system in a HRO, the organization can construct networks and teams with individuals having different competencies and roles. Depending on their role and their background these individuals will look for different things when they evaluate a problem.

Further, requisite variety can also be influenced by the richness of information in the domain. There are several means of communication in organizations reaching from direct face-to-face communication to written formal communiqués (e.g. letter, memos, bulletins, documents). The information richness declines as people move from face-to-face communication towards interaction via the telephone, letters, documents etc. A rich communication can provide multiple cues and quick feedback helping the organization to match the complexity of the technical system used. But
information richness can also have negative consequences as there is a tendency for overcomplicating when there is too much information, making the work ineffective (Weick, 1987).

2.4.1.4 Reliability as enactment
As mentioned above, information richness is central for the requisite variety of the operator regulating the technical system. This richness is constructed through interaction within the organization and with the outside world. This can provide useful cues and feedback (Weick, 1987).

Weick (1987) found evidence on how operators in the aviation domain actively create information richness through interaction with the pilots in their control area. The air traffic controller used the verbal interaction on the radio to build up more detailed knowledge of the environment and an understanding of how it possibly could develop. According to Weick (1987), this is a way of enacting reliability in an organization and it underlines the fact that reliability itself is a context-dependent condition rather than a specific event.

2.5 The VTS as a HRO
To summarize, HRO is a perspective offering various characteristics which can be useful for the analysis of an organization.

- HRO are very complex organizations composed out of various sub-systems (Roberts, 1990)
- Sub-systems consists of both operators and technological systems with high hazardous potential (Roberts, 1990)
- Safety arises as a culture among the levels of the organization through information mediation and the enactment of reliability (Weick, 1987)
- HROs are services to the general public, but are not often recognized as such by the public (Roberts, 1990)
- HROs are constrained by political, economical and market regulations (La Porte, 1996)
- In HROs safety is either the main goal or the main reason for existence (Leveson et al., 2009)

In the VTS domain there are different sub-systems, technical and non-technical, which are interdependent and have tight couplings with each other. The technical complexity of the system (e.g. the integration of different decision tools) as well as the complexity of the organization itself characterizes VTS as a HRO.

VTS as a domain is highly interesting for research concerning safety and organizations. An international framework of guidelines and regulations states the scope of the work of the VTS. The actual constraints on the work of the operators are constituted by the Competent Authority in each country and can even differ between VTS centres in one state.

VTS is a service to the general public, but it is not recognized as such by this public. Due to major shipping accidents in the 1970s the rising public awareness shaped the introduction of the VTS as an organization with the purpose to enhance the safety of life at sea as well as the safety and efficiency of navigation. In many sensitive sea areas and areas with a high traffic density VTS centres have been implemented to increase safety. Without these services to the maritime community there would not be any independent information service, navigation assistance and/or traffic organization. The risk for major shipping accidents would increase immediately and could have consequences for large parts of the general public.
In high reliability organizations operators interact with large technical systems. In a VTS centre an operator interacts with a decision support system to be able to fulfil his daily work tasks. A decision support system normally is a complex technical aid which should support the decision making of a VTS operator. The system often integrates information from several marine aids such as RADAR, AIS (Automatic Identification System) and electronic navigation charts. Normally information is displayed on several computer screens (Lützhöft et al., 2009).

Depending on the services offered by a VTS centre the use of the support system differs. But in general, one can state that the systems used in the VTS domain are highly complex. Due to the complexity of such decision support systems, the operators need not only to learn how to operate the system, but also how to interpret and how to make use of the information presented in the system (Lützhöft et al., 2009). This connects to what Leveson et al. (2009) see as characteristic for workers in HROs. They have a high degree of knowledge on technical details.

Further, Leveson et al. (2009) stated that the HRO perspective is not applicable to all kinds of industries. It is rather limited to organizations and industries which have safety as the main goal, main reason or constraint for their existence and which have good safety records. VTS is a service implemented with the purpose to enhance the safety and efficiency of navigation as well as the safety of life at sea. Therefore actions performed at a VTS always have the main goal of achieving safety. This goal is achieved through assisting the maritime traffic in the VTS area. Lately there have been statistics on when and in what way VTS operators have actively worked for the prevention of incidents. The Sound VTS in Malmö, for example, has started to collect statistics on incidents in which operators interacted actively with the traffic to prevent groundings and accidents. This also suggests
that reliability in the VTS as organization is a non-event, characterized by the absence of accidents and incidents in the VTS area. VTS operators can act differently from each other depending on their experience and background, but still, the outcome is supposed to be the same; efficient and safe traffic movements in the VTS area. In short, the dynamic input (the VTS operators’ actions) produces a constant output (safe and efficient traffic movements).

On the operational level the VTS can be identified as a HRO through the enactment of reliability. Similar to the aviation domain, the VTS operators contact the vessel in the VTS area to build up a higher degree of information richness. Through the services offered by a VTS, the operators are forced to interact with all vessels in the area, at least when they are answering or leaving the area. The interaction is carried out via a VHF-radio. All information necessary is asked for and is used to enhance the information richness through offering more knowledge on details of the situation.
3 Method

In the following chapter methods used for the data collection and analysis will be presented.

3.1 General description

Ethnographic field research involves the study of groups and people as they go about their everyday lives. (Emerson, Fretz, Shaw, 1995, p.1)

As Emerson, Fretz and Shaw (1995) state in the quotation above, ethnographic field research involves the study of groups and people in their everyday life. Further, to be able to understand people and their everyday lives one needs to understand what their experiences and activities mean to them. Maritime safety is something present every day as an objective for the VTS. To be able to understand the operators’ activities and experiences concerning maritime safety an ethnographic approach was chosen. The research was mainly conducted on site; meaning interviews and an observation were conducted in VTS centres close to or at the worksite of the operators to get social proximity to the operators, their activities and their experiences.

Emerson, Fretz and Shaw (1995) write further that the task of field research is not to determine the truth, but rather to uncover multiple truths which are part of peoples’ everyday life. Therefore this study does not aim to reveal one truth about maritime safety, but rather the different perspectives that individuals and representatives of organizations have on this specific type of safety. This thesis is about exploring this concept by looking at everyday routines of the VTS operators at work and how their actions are meaningful for the promotion of maritime safety from their perspective.

Apart from VTS operators, representatives of other organizations central in the maritime sector were interviewed on their definition of maritime safety. Further, an observation at a VTS centre was conducted.

During the data collection three different methods, a literature study, interviews and observations, were used to gather data.

![Figure 2: data collection process.](image)

In the figure above (figure 2) the data collection is shown as a process. I started by conducting a literature study on the central actors in the maritime domain. It was followed by interviews with representatives of three actors in the Swedish shipping domain and with four VTS operators. These interviews were conducted prior to the observation and were used to determine a focus for it.

Finally, a two-day-long observation at a VTS centre was conducted. The observation was an open observation. I acted as “observer as participant” (Gold, 1958 as cited by Bryman, 2002) and was participating through interviewing the VTS operators during the observation. But still, the participation was held on a rather passive level (Bryman, 2002) as there was, due to the safety critical environment of the VTS, no active involvement in the actions of the VTS operators.
3.2 Literature study
I conducted a literature study gathering information on the actors and on their definition of maritime safety. The homepages of organizations, guidelines and recommendations were studied to get a notion on how this specific type of safety is defined. The results of this literature study are summarized in both the background (1.2) and chapter 4 of this thesis.

3.3 Interviews
To explore the concept of maritime safety 12 interviews were conducted. There were two groups of interviewees; one of eight VTS operators and one VTS manager working at two Swedish VTS centres and one group of three representatives for different actors (SMA, SSA, STA) in the maritime sector.

3.3.1 Interviews with actors in the maritime sector
Three interviews with representatives for actors in the maritime sector were conducted. The interviewees were chosen according to their position in the specific organization. It was paid attention to that the representative had a connection to maritime safety or VTS as part of their job description. Due to the availability of interviewees, it was chosen to interview representatives of Swedish actors in the maritime community.

The interviews were semi-structured and followed an interview guide with six questions (Appendix A). Apart from the questions in the guide, follow-up questions were asked to get more detailed and substantial answers of the interviewees. The interviews were focused on the definition of maritime safety and what the specific actor does to promote safety in the maritime domain. All three representatives were asked the same questions.

The interviews were chosen to be semi-structured as the goal was to be able to compare the data from these interviews to data obtained from the observation and from the interviews with the VTS operators.

Two of the interviews were recorded. They took approximately 40 minutes each. Additionally, notes were taken during the time of the interview to complement the recording.

One interview was conducted as a telephone interview which took about 25 minutes. During the interview no recordings were made, but notes were taken to be able to reproduce the respondent’s answers after the interview was finished.

After an interview the evaluation process started right away by transcribing the interview verbatim. As all interviews were held in Swedish, I did not only transcribe the interviewees’ answers, but also translated them into English. After the translation all interviews were summarized. Further, each respondent was granted to look through the summarized text and to comment on it to avoid misunderstandings and to make sure that the translation reflected the interviewees’ answers.

3.3.1.1 Interview with the Swedish Maritime Administration (SMA)
The interview with the representative of the SMA was conducted at SMA’s main office in Norrköping. A minor conference room was used as a location. The interviewed representative is the head of Maritime Policy and Public Affairs.
3.3.1.2 *Interview with the Swedish Shipowners’ Association (SSA)*

The interview was conducted at the office of the Swedish Shipowners’ Association in Gothenburg. The interviewed representative is responsible for the areas maritime safety and technology.

3.3.1.3 *Interview with the Swedish Transport Agency (STA)*

The interview with the Swedish Transport Agency was conducted as a telephone interview. Due to time pressure and the availability of the respondent, this type of interview was chosen. The interview took approximately 30 minutes. The interviewee is part of the maritime sector of the STA and is responsible for VTS in Sweden. In addition to the chosen representative, I also had the chance to talk to the head of the maritime sector of the Swedish Transport Agency.

3.3.2 *Interviews with VTS operators*

Prior to and during the observation short interviews with VTS operators were conducted. The interviews were semi-structured and followed an interview guide consisting of 5 basic questions concerning the definition and the promotion of maritime safety as part of the daily work of an operator (Appendix B). Follow-up questions were asked when it was found necessary to clarify the answer of the interviewee. All in all, eight VTS operators and one VTS manager from two different VTS centres (Sound VTS, VTS West Coast) were interviewed. All interviewees were men and had a maritime background with several years, at least about ten years, as active seafarers.

The interviews conducted prior to the observation were recorded with a recording device and took between four and ten minutes each. They were focused on the operators’ understanding of maritime safety and how this concept is influenced by and influences his daily work. Four interviews were conducted. During the interviews notes were taken. Afterwards they were transcribed verbatim and translated into English.

These short interviews were conducted prior to the observation to get insights on how the operators themselves define maritime safety and their influence on it in connection with their daily job. Further, the interviews were intended to give insights regarding which actors the operators work with and how their work itself is influenced by international guidelines and recommendations. Further, the interviews were used to guide the observation and its scope.

During the two days of observation, four more VTS operators and one VTS manager were interviewed. The interviews followed the same interview guide (Appendix B) and follow-up questions were asked when necessary. These interviews differed from the first four ones as there was no possibility to record them. They took part during the observation at the VTS centre and were interrupted as the operators were working during the time of the interview. Therefore the questions were asked when it was judged to be appropriate depending on the traffic situation.

3.4 *Observation*

To complete the data collection a two-day-long observation at a VTS centre was conducted.

3.4.1 *Preparations and tools*

Prior to the observation a guide with areas of interests was developed. Guided by HRO theory I chose 5 main topics to be the focus of the observation. These topics were communication, enactment and information richness, cooperation with other actors, a typical passage and other. Each topic had several central questions that were supposed to guide the observation (Appendix C). Being the only
observer in a complex environment, the guide was used to help me focus during the time of the observation as well as to connect the theory with observable events.

Further, I prepared information sheets and consent forms for the participants of the observation. The information sheets summarized the main objectives of the study and informed the participant on how the observation was going to be conducted and what his contribution to it would be. It also informed about the confidentiality of the collected data as well as the right to abort the participation. The consent form was used to confirm the participation and get the participants’ consent. As Barrett (1995) emphasizes, it is important that research follows general ethical principles. To obtain a participants informed consent is the basis for the ethical feasibility of any research project.

The observations were recorded through field notes made during the time spent at the VTS centre. Beside field notes, photographs of the operators’ workstations were taken.

3.4.2 Procedure
The observation was split into two parts of five hours each on two different days. The observation was conducted during the day in order to be able to follow the normal working procedures and routines of an operator at work.

Before the observations started all involved individuals were informed about the study and its purpose. A handout with information about the study was given to all participants. They were also asked to confirm their consent to participate by signing a consent form. The observation started after all participants had signed their forms. Participation was voluntary and the involved operators were informed that they could abort their participation at any time without giving a reason.

Prior to the observation, the VTS manager explained that there normally is more traffic in the area of the VTS Gothenburg than in the area of VTS Lysekil or VTS Marstrand. Therefore I chose to sit behind the VTS operator for the VTS Gothenburg area during the two days of observation.

I took field notes during the observation as main recording method. The focus was on recording typical interactions between the VTS operator and various actors, e.g. different vessels or the port operators. At the same time informal interviews were conducted by asking the operator what he was doing and why. The only restriction for the interview was that it was not supposed to interfere with the operator’s duties. The interview questions were formulated non-directed and were, most of the time, directly related to an ongoing activity of the operator to get a better understanding for what he was doing and why.

3.5 Analysis of the collected data
Each method outlined above was used to obtain a different type of data to explore both the perspective of the representatives and the one of the VTS operators. Each interview was first transcribed verbatim and then translated into English. In an additional step the interview then was summarized to underline the aspects important for this thesis.

The first step was to compare what the various definitions of the actors in the maritime domain had in common and to what extent they differed. Further, these definitions where compared to the data collected in the interviews with VTS operators.
The interviews conducted with VTS operators prior to the observation were used to highlight specific aspects of the daily work of an operator to be able to construct a guide for the observation. The interviews conducted during the observation were meant to connect the observed data to the perspective of the operators.

As there was no possibility to record the interviews without influencing the observation, only notes were taken. Those notes where then used to reconstruct the interviewees’ answers. All answers were analyzed by comparing them to each other to see to what extent they had varied concerning maritime safety and which explicit action the operators identified as part of their work to promote this specific type of safety. In a second step, the answers were compared to the ones from the interviews prior to the observation which were not conducted on site.

The analysis of the data obtained from the observation was started as soon as I had left the VTS centre. After each day of observation the field notes were typed and structured according to the topics which were set up prior to the observation. Further, the notes were sorted chronologically including making differences between personal comments and actual activities and actions they conducted. After completing the sorting of field notes, I tried to find similarities and differences in the working routines of the operators that I had observed.
4 Results

This chapter presents the results of the data collection.

4.1 Maritime Safety – an overview of the international actors’ perspective

The interviews and the observation had the purpose of approaching maritime safety from the perspective of the actors involved in the shipping domain in Sweden. To be able to understand how international actors, such as the IMO, IALA and EMSA define this specific kind of safety, a literature study was conducted. Various guidelines and recommendations concerning maritime safety were studied as well as the information displayed on the actors’ homepages. In specific, documents regarding the VTS/ SRS and its functions were studied.

4.1.1 IMO

The IMO has no official definition of maritime safety. Instead, there is the so-called SOLAS Convention. SOLAS is an abbreviation for “Safety of Life at Sea” and this convention was first published in 1974. It consists of eleven chapters which highlight aspects concerning safety at sea, e.g. Safety of Navigation (Chapter V), Safety Measures for High Speed Craft (Chapter X) ("International Convention for the Safety of Life at Sea,” 1974).

For this thesis chapter V was studied in detail as it deals with the safety of navigation. Regulation 11 (SRS) and 12 (VTS) define the function and scope of VTS and SRS. Both services are defined to contribute to the safety of life at sea, safety and efficiency of navigation and the protection of the marine environment.

Further, neither on the homepage nor in any other document studied maritime safety is explicitly defined. Therefore it is concluded that the IMO defines this specific type of safety as what is stated in the SOLAS convention in Chapter V; the safety of life at sea, safety and efficiency of navigation and the protection of the marine environment.

4.1.2 IALA

The IALA has no explicit definition of maritime safety, neither on the homepage nor in the IALA VTS Manual (IALA, 2008). Although there are references regarding the work of the IMO with maritime safety, there is no definition. Through information on the homepage it was possible though, to find a definition of safety.

Safety, according to the IALA, is the “Condition at which, even under the possible effect of hazards, defects or stresses, the intended purpose of an installation (equipment) or of a process is guaranteed to the necessary extent.” (IALA, 2009)

4.1.3 EMSA

Although the European Maritime Safety Agency is assisting the European Commission in implementing and developing a European legislation on maritime safety (European Maritime Safety Agency, 2009), there is no explicit definition on maritime safety to be found, neither in the information on the homepage, nor in any document studied.

The main objective of the EMSA regarding maritime safety is the so-called SafeSeaNet, a vessel traffic monitoring and information system ("Directive 2002/59/EC of the European Parliament and of the Council of 27 June 2002 establishing a Community vessel traffic monitoring and information system
and repealing Council Directive 93/75/EEC," 2002) which was introduced to enhance the safety and efficiency of the maritime traffic. It is a mandatory information system which is supposed to give the Member States access to all important information regarding vessel movements, especially with focus on ships carrying hazardous cargo. The system’s goal is to improve the response of authorities concerning accidents, incidents or other potentially dangerous situations.

VTS, according to the information gained from the directive ("Directive 2002/59/EC of the European Parliament and of the Council of 27 June 2002 establishing a Community vessel traffic monitoring and information system and repealing Council Directive 93/75/EEC," 2002), is a service to improve the safety and efficiency of the traffic and to protect the environment through interaction with the vessels and responding to traffic situation which develop in the area.

As the IMO and the IALA, EMSA has no specific definition of the term maritime safety. In the information on the homepage and in the directives studied, maritime safety is named several times as a central concept in the shipping domain, but no further definition is made. It is concluded that this specific type of safety is the overall safety of navigation, of individuals and the environment.

4.1.4 Lloyd’s Register
Lloyd’s Register was chosen as a representative for a classification society. As there was no specific information on maritime safety available on the organization’s homepage, a definition of the concept of obtained via an email-contact. According to the informant, Lloyd’s Register works with following definition of maritime safety:

"Safety is a perceived quality that determines the extent to which the management, engineering and operation of a system are free from danger to life, property and the environment."

4.1.5 Summary of the literature study
Although several different sources were studied, the only organization with a concrete definition of maritime safety was Lloyd’s Register. All the other international actors used maritime safety more as a concept which is achieved through the improvement of different measures, such as SafeSeaNet.

Further, it seemed like the international actors used maritime safety as an umbrella term for various kinds of safety connected to the maritime domain including the safety and efficiency of navigation, safety of life at sea and the protection of the marine environment.

4.2 Interviews
In this section the result of the interviews is presented. All quotations are written in italic letters and stand for answers which were originally given in Swedish by the interviewees and which then were translated into English.

4.2.1 Interviews with representatives
Each interview with a representative is going to be presented separately to highlight the different definitions of maritime safety. In the end of the section a summary of the results from this part of the study is given.

4.2.1.1 Swedish Maritime Administration (SMA)
The SMA defines maritime safety as the combination of fairway design (presentation and design), pilotage and VTS with the main goal to minimize the number of accidents and incidents. It is not
defined in which order these three aspects are important to maritime safety, but one should keep in mind that there is a certain cost for every measure. Therefore the goal needs to be to maximize the safety improvement in relation to the cost of the implemented measure.

To promote maritime safety the SMA works with ensuring the quality of the fairways. This is done by measuring the depths in the fairway and marking it according to those measurements in navigational charts. In addition to fairway maintenance and marking, the pilots and the VTS are part of the promotion of maritime safety by the SMA. The pilot is the local consultant who has expert knowledge on the local area. This expert knowledge is often hard to represent in navigational charts. The VTS is responsible for providing information service to the vessels in the area. Such information can include information on traffic (e.g. upcoming meetings between vessels), navigational warnings and information on weather and water level. The information might even be a reminder of a special condition of some kind, e.g. any kind of anomaly in the fairway.

The SMA cooperates with the Swedish Transport Agency to promote maritime safety. The Transport Agency’s shipping sector was a part of the SMA until January this year (2009). Therefore the competencies concerning maritime safety are shared between the two organizations and they work closely together. Further, on an international level the SMA works with the IHO (International Hydrographic Organization) to keep the international standard for navigation charts.

“Shipping is a global business and it is important that information is presented in the same manner worldwide”

On the local level, the SMA leaves the cooperation to their area representatives. They decide who to cooperate with and what issues to address locally. Possible cooperation partners are e.g. a recreational boating club.

Concerning a possible improvement of maritime safety, the representative named that there are many different ways of improving; better information concerning the depth of the fairways, more traffic separation schemes (such as in the Bornholm area) and the use of AIS for surveillance of vessels.

4.2.1.2 Swedish Shipowners’ Association (SSA)

The Swedish Shipowners’ Association defines maritime safety as the guarantee of quality shipping. As maritime safety is a concept with several components the quality of both vessel and crew need to comply with international rules and guidelines. ISPS, MARPOL, SOLAS, STCW are just some examples of important rules. However, there is a general problem with the compliance on an international level.

“If everybody was compliant, the shipping community would already have a high degree of the so-called maritime safety.”

To promote maritime safety the Swedish Shipowners’ Association works on various levels. It informs and updates its members, has an active dialogue with international and national authorities and finances research in the shipping domain. It is important to be proactive and shape the future of shipping through research projects. Further, there are several systems developed by the SSA amongst other organizations, INSJÖ, a database concerning incidents and accidents, is just one example.
As mentioned above, the SSA has an active dialogue with international and national bodies. It is important to overcome the gap between the industry and the governmental organizations working in the shipping domain. On the national level the SSA works closely together with the STA and the SMA. On the international level, the SSA is part of the IMO delegation. Further, there is a close cooperation with the International Chamber of Shipping (ICS) and the European Community Shipowners’ Association. There is also cooperation with several national organizations such as the coast guard, the police and various schools in which seafarers are trained (e.g. Chalmers University of Technology, Kalmar Maritime Academy). Additionally, the SSA arranges seminars and lectures and assists their own members.

The SSA expects the VTS to be a service that promotes maritime safety, but this also means that there is the need to have active VTS operators. The VTS should be the central organ for all communication in a VTS area. All seafarers need to be made aware of that there is an information service which can be called. Further, VTS operators should be more active than they are today. There have been several situations where more direct and strong recommendations from the VTS have been needed but the operators seemed to be afraid of interfering with the traffic. They acted too passively. Further, the VTS should always be a local service offered by VTS operators with expert knowledge of the area. According to the interviewee, the operators have a duty to inform the vessels in the area as soon as they can see indicators for upcoming meetings or any other conflicting situation.

“VTS is about communication and if you don’t have this communication, there is no need for a VTS. But still, a lot of experienced seafarers say that without the VTS and the ship-to-ship communication they would feel unsafe to go into different traffic situations.”

In the light of the future, the SSA points out that maritime safety can be improved through working proactively. Accidents do not need to happen if one reacts towards incidents. This is also an area where more research could lead to a general improvement of maritime safety. Additionally, traffic separations in the southern Baltic Sea Area, around The Skaw and in the Great Belt could be a practical measure for an improvement.

4.2.1.3 Interview with the Swedish Transport Agency (STA)

The Swedish Transport Agency does not have an exact definition of maritime safety. Maritime safety is rather seen as an umbrella term including all measures that are supposed to be improved to achieve a high degree of safety.

To promote maritime safety, the STA formulates rules and regulations concerning the shipping domain, e.g. through vessel equipment requirements and pilot liability, and practices supervision on all vessels sailing in Swedish waters. Further, STA is responsible for the Swedish Register of Shipping and analyses accidents and near-misses in order to learn from them.

The STA works on both a national and an international level for promoting maritime safety. On a national level it cooperates with amongst others the SMA, the Coast Guard, municipalities, county administrative boards, ports and the Swedish Shipowners’ Association. The cooperation is mostly carried out through consultation with these different organizations whenever new rules or regulations are formulated. Every organization whose members are affected by a change is contacted
and has the possibility to express its concerns. Further, before any rules are formulated, there is always a thorough analysis carried out by the STA.

The STA works actively and continuously on an international level together with IMO, IHO, ITU, EU, Paris MoU, HELCOM and IALA amongst others for the development and harmonization of international rules, regulations and guidelines concerning shipping. Through participation in various committees, issues concerning rules, recommendations and guidelines are raised. Shipping is an international business and the STA works to minimize additional national requirements for vessels falling under international conventions and agreements.

To improve maritime safety the regulating framework for shipping needs to be easy to understand so that the rules and recommendations can be followed. This can be achieved through better information to the shipping community. The STA informs the shipping community e.g. through information on its homepage and newsletters. It works also with reference groups as a forum for information and discussions regarding interpretation of rules and regulations. Further, cooperation with the Swedish Shipowners’ Association as well as with the Swedish Shipbrokers’ Association is used as links to the vessels.

With a focus on Vessel Traffic Services (VTS), maritime safety can be improved in the designated VTS areas through information on rules and procedures for these areas. Currently the STA is concerned with improving the communication between VTS, pilots and mariners to shape a mutual understanding. Communication is seen as central for the VTS. Clear communication and good cooperation between all parties involved are essential for the vessel’s safe passage in a VTS area.

In the opinion of the STA, Vessel Traffic Services plays an important part of the system promoting maritime safety. VTS is a service which monitors the traffic, informs and assists the participating vessels in order to improve safety and efficiency of the vessel traffic and to protect the environment.

“It is important that all participating vessels are treated professionally”

If a VTS is implemented, it should have the capacity of working proactively and respond to traffic situations developing in the VTS area. Swedish VTSs provide an information service and this service should have the capability to interact with traffic and assisting the vessels in the navigational decision making process on board. In general, VTS should manage to produce a reliable and accurate traffic image at all times and be prepared to act accordingly.

4.2.2 Interviews with VTS operators

“Maritime safety is that nothing happens, that the traffic moves fluently without any accidents or environmental pollution”

The VTS operators answered the interview questions quite similarly. In general, maritime safety was defined as the safety of life, environment and vessels in the VTS area. Further, essential for maritime safety is that there is a general compliance to current recommendations and rules. Technical equipment, such as well-working RADAR with a good coverage over the area, was also pointed out as essential. Additionally, it was emphasized that maritime safety is a concept that builds on a rested bridge team, on good English language skills and that the ship-owners have an understanding on what is going on on the bridge. Tight schedules and fatigue are risks to the safety of navigation but
this does not always seem to be an issue for shipping companies, which normally try to work as cost-effective as possible.

When asked what the operators do to promote maritime safety, traffic monitoring and information service was named. Based on experience, the operators monitor all vessels closely and follow their way through the area. Whenever a vessel seems to leave the intended course, they interact with it to get the officer of the watch aware of the situation. Those interactions are proactive interventions to prevent upcoming accidents and incidents. Depending on the area, there are different hot spots which are monitored more closely as the time to react upon a vessel’s movement might be very limited. Those hot spots are often identified by making use of the expert knowledge gained through both experience as an active seafarer and as a VTS operator.

“You always have to be one step ahead”

One operator also mentioned that his experience as an active seafarer influenced his daily work regularly as he is aware of the fatigue that many officers of the watch suffer from.

“I am especially alert when there is a vessel passing in this area and they have no pilot onboard. The skipper has normally been awake for many hours and he just gets about two hours of sleep when the vessel is in the harbour. Then he is on watch again”

Another operator also said that he might act more actively than he actually is allowed to as the Swedish VTS is only offering information service and does not offer active navigational assistance or advice.

“Sometimes I help the pilot through giving information containing a concrete course so that the vessel is in the right position for the pilot to go on board.”

According to the VTS operators they promote maritime safety through the cooperation mostly with the vessels in the area, pilots, port operators, port control, colleagues and search and rescue authorities (MRCC, JRCC). Only one operator named the SMA as a co-operator concerning the promotion of maritime safety.

Communication was pointed out as the part of the daily work which was mostly influenced by international guidelines and recommendations. Through the mandatory use of Standard Marine Communication Phrases (SMCP), communication has been standardized worldwide and the VTS operators are supposed to use those communication phrases. Only two of the eight operators mentioned that they were influenced by other recommendations, e.g. recommendations concerning specific types of vessels, in the way that they ought to report if any vessel is not compliant. Further, one VTS operator mentioned that international guidelines do not always have a positive effect on the VTS as they can lead to more work that might take focus from the task of monitoring.

“It depends on the situation. We were supposed to control if all vessels were compliant and had to report those that were not. That was a lot of extra to do”

Concerning the improvement of maritime safety, all operators pointed out that there is the need to improve the educational standards of the seafarers today. It was pointed out that there is a lack of
English language skills, in specific English navigational vocabulary, as well as decreasing navigational competence.

“You have to be able to understand and make yourself understood. Sometimes people just don’t understand. That is a safety risk”

The need for common international standards was also mentioned as important for the improvement of maritime safety. Even standards for VTS operators should be established on an international basis. A background as an active seafarer is a must to be able to understand the needs of the bridge team. One operator also mentioned that a common education of pilots and VTS operators might lead to an improvement and another operator mentioned the need for refresher courses so that the level of education is on a constantly high level.

Further, a few of the operators emphasized deficiencies in the technical equipment, mainly concerning the RADAR and that it would be nice to have CCTV cameras to be able to look at traffic situations from several perspectives.

Another focus was on the lack of understanding for the VTS. Some operators pointed out that they do not feel appreciated due to the fact that they thought that decisions concerning the VTS were too often based on financial reasoning, not with bearing maritime safety in mind.

4.3 Observation
In this part of this chapter the results of the observation conducted at the VTS West Coast are going to be presented. Extracts of the field notes and comments of the operators are presented in italic lettering.

4.3.1 Location
The observation took part at the VTS West Coast. The VTS West Coast is located at the Skandiahamn in Gothenburg. It is on the fifth floor of a building right at the entrance to the port of Gothenburg. The VTS West Coast offers services to three different VTS areas: VTS Gothenburg operated by one operator, VTS Lysekil and VTS Marstrand, which are both operated by the same operator. VTS Gothenburg has the highest traffic volume while VTS Marstrand and Lysekil have less but more specific types of traffic movements. I spent five hours, from 10 a.m. to 3 p.m., during two days at the VTS centre. During the observation I was sitting behind the VTS operator for the Gothenburg area and the port of Gothenburg.

There are 14 VTS operators working at the VTS West Coast. All operators work in a two-shift system with six hours on, six hours off duty. The day-shift is from 6 a.m. to 12.30 p.m. and 6 p.m. to 12.30 a.m. and the night-shift from 12 a.m. to 6.30 a.m. and 12 p.m. to 6.30 p.m. Every period of duty overlaps 30 minutes at the beginning and at the end to have time to inform the operator, who is about to start his shift, on the current traffic situation and on events which have happened during the last hours. The operators work according to a rotation system, working night- and day-shifts and shifting between the two stations (VTS Gothenburg, VTS Marstrand/VTS Lysekil). During one year an operator has 480 hours of duty as a VTS operator and 19 days of education.
4.3.2 The operators
The operators working at the VTS West Coast all have a background as active seafarers. Having a background as active seafarers is seen as something essential as it is necessary to understand the needs of bridge-teams on the vessels in the area.

All operators at the VTS West Coast were trained in accordance with IALA guidelines. The guidelines state that the basic education of an operator consists of eight subjects (Language, Traffic Management, Equipment, Nautical Knowledge, Communication co-ordination, VHF Radio, Personal Attributes and Emergency Situation) which are taught during approximately 240 hours. Each subject is taught by both theoretical (teaching) and practical (simulation) methods ("IALA Recommendation V-103 on Standards for Training and Certification of VTS Personnel," 1998).

After a basic course, the VTS operator-to-be is educated by on-the-job training. On-the-job training has the objective of providing a new operator with thorough knowledge of the area and the services offered by the specific VTS centre the operator aims to work at ("IALA Recommendation V-103 on Standards for Training and Certification of VTS Personnel," 1998).

All operators who took part in the observation were trained Master Mariners and had been working several years as active seafarers before becoming a VTS operator. To be a Master Mariner is one prerequisite an operator should fulfil according to the SMA. One operator even had a background as a former pilot.

4.3.3 The equipment
As three different areas are attended by two operators, there are two different workstations.

![Figure 3: The workstations of the VTS Gothenburg (left) and the VTS Marstrand/VTS Lysekil (right)](image)

Both workstations consist of similar system setups. The system is located on a u-shaped table which is adjustable in its height. The operators can choose between sitting and standing in front of the table.

On the left of each table is a camera display. On the display the operators can choose to show the view of one of the five, four monitoring the VTS area and one showing the parking lot outside, CCTV-cameras. The cameras are located on four different spots in the whole VTS area: Kärringberget, Rosenlund, Marstrand, Galterö. They can be used to zoom in or out to get a better impression on the traffic situation. The two operators, who I followed through the two days of observation, mostly used the Kärringberget and Rosenlund camera. The Marstrand camera is mainly used when working at the
VTS Marstrand/ VTS Lysekil station. The last one of the cameras is located at the building the VTS centre is located in. It can be used to show the parking lot outside of the building.

The biggest part of the VTS stations is occupied by screens showing a digitalized nautical chart of the area. In the area of the VTS Gothenburg this chart is split over four screens; in the area of VTS Marstrand/ VTS Lysekil five screens are used to show both VTS areas. On the digital chart all vessels in the area are presented as RADAR targets. Additionally, AIS information is integrated in the system so that the name of all vessels equipped with AIS can be presented on the display. The view on the area on the screens can be changed through zooming in and out. Further, it can be chosen which information about a vessel should be presented. However, the operators, who were followed during the observation, mentioned that they choose not to change any preferences as it takes too much time to adjust the information when shifting from on to off duty.

Further, each station has a computer which is connected to the internet and which is used to display the Vessel Traffic Management System (VTMS) and the pilot-ordering database (Farled). The operators also use the computer to check their emails or to look up information on the internet.

Both stations have a VHF hanging from the ceiling which is used for communication with the participating vessels in the area. Further, there is a telephone with a digital display which can be used for regular calls and as an additional VHF (in the VTS Marstrand/VTS Lysekil area). The VTS Gothenburg has an extra VHF located on the left hand side of the VTS station. It is mainly used as a possibility to listen to either ship-to-ship communication or to listen to the communication of pilots, harbour and tugboats.

4.3.4 A typical passage

It is hard to define a typical passage as there are different guidelines in respect to the type of vessel. In the VTS area of the VTS Gothenburg most of the vessels enter the area to either perform bunkering or to go into the harbour. Depending on size, cargo and frequency of visits there are different ways to handle the vessels.

Normally a vessel reports four times from the entrance of the VTS area until the quay, unless complications arise. It reports when it is entering the area, when a pilot has boarded, when it is entering the inner harbour area and when it is at the quay. The vessel complies to the protocol by reporting at the different mandatory reporting points where all vessels have to report. The only exceptions are leisure craft and small fishing vessels.

Through the time of the passage the VTS operator follows the traffic movement on the digital navigation chart on the computer screens in front of him. As the vessel moves from the entrance towards its destination the operator uses the information displayed in either “Farled”, the pilot ordering service database, or in the Vessel Traffic Management System (VTMS) operated by the port control. Both databases contain information on the vessels in the area, inbound and outbound traffic movements. Even detailed information on the cargo, ship’s characteristics (e.g. draught, IMO number, estimated arrival time), shipping agent and pilotage can be accessed through these two databases.

A vessel calls for the VTS Gothenburg on channel 13. It wants to confirm a pilotage for the day. The VTS operator checks the information displayed in Farled, gets up and calls for one of the pilot ordering
operators on the other side of room. “Is there any pilotage for XX?” The pilot ordering service confirms that there is no pilot ordered for this vessel today. The VTS operator sits down, looks at the screen showing the entrance to the area and calls for the vessel “XX, VTS Gothenburg, your quay is occupied by another ship. Please contact your agent”

The operators use the information to make sure that vessels are sailing the way they are supposed to sail. If there are discrepancies in the information displayed in the database and the behaviour of a vessel in the area, the operator takes action.

4.3.5 Communication
The operators use several VHF channels and the telephone to communicate with others. Further, as the pilot ordering service and the three VTS areas are operated from the same location, there is also verbal communication between the two VTS operators and the VTS operators and the pilot ordering service.

4.3.5.1 VHF communication
There are 7 different VHF channels that the operators of the VTS Gothenburg use; Channel 13 (VTS Gothenburg), 73 (Gothenburg pilot), 12 (Skarvikshamn), 69 and 8 (pilots and tugboats), 6 (ship-to-ship communication in the area) and 16 (emergency channel). Generally all communication via VHF is held in English. The use of SMCP is mandatory. But the operators make exceptions. Two operators mentioned that the communication phrases are not always optimal and that they feel the need adapt their communication to the situation. In the case of an emergency, for example, there would not be enough time for repeating all messages. Further, the operators showed different attitudes towards the amount of communication on the radio.

A ferry contacts the VTS Gothenburg in Swedish. It is the pilot asking for upcoming traffic in the area. He is asking in Swedish “Vad är det för färja som kommer in?” The VTS operator looks closely at the first screen which displays the area and its reporting lines. Without repeating the question or using the mandatory communication phrases, the operator answers “XX”.

In the situation above it is shown that not all operators use the mandatory communication guidelines in all contexts. If the operator was using them, he would have repeated the question and would have used the message markers such as “question” and “answer”. The operator explained that the use of message markers and the repeating of a message is context depending. Further, the operator does not really see a necessity of answering in English if the vessel in question is calling in Swedish.

The operator talks about conversation standards and mentions that the use of English can be intimidating to some older seafarers who have been sailing in this area for years. He concludes that it is better to encourage them to report by answering their calls in Swedish than to intimidate them by the use of English.

4.3.5.2 Telephone
During the two days of observation most of the communication was on the VHF radio, not on the telephone. All in all there were just a few phone calls and most of them concerned the RADAR equipment of the VTS. Only one call concerned information that the VTS operator was supposed to spread to the traffic in the area. It concerned a slight oil spill outside of the dock in the inner harbour area. Two calls regarded the water levels, but one of them concerned a location outside of the VTS area.
A person calls and asks for the water level in the area outside of Kungaälv. The operator informs the person on the water level in the Gothenburg harbour and looks up a telephone number for the VTS Trollhättan. When the call is finished the operator comments “I could have helped him but it seems like if you open that door, there are just going to be more and more people that call”

As the telephone number of the VTS can be looked up easily on the internet if felt like that there are many calls that come in that regard areas not actually part of the work description of the VTS. Whenever an operator answers a telephone and is forced to look up information, his attention is drawn from the screens displaying the area. Although calls via the VHF are always prioritized, it is physically impossible to look up information, e.g. a telephone number, and to monitor the area at the same time.

4.3.6 Enactment and Information Richness

Depending on the station the VTS operators work at, they choose different information sources. All operators seemed to use at least three information sources, the internet (VMTS, Farled), the VHF communication and the information displayed on the screens showing the area. Sometimes the CCTV cameras and the hydro-meteorological information were used. However, all operators underlined that the use of information sources is highly situation dependent, e.g. the CCTV cameras are really useful during the day and during good weather conditions, but they do not offer that much information during the night or in foggy weather.

When a vessel passes the reporting line to the VTS Gothenburg area, the operators pointed out draught, destination (quay number or anchorage area) and intention (is the vessel taking the southern or northern channel) as important information they wants to know. Through this information it is possible to inform the vessel on upcoming traffic encounters. Further information concerning the planned route can be given to them, e.g. oil spills, current etc. This is part of the operator’s job and can be defined as proactive. One of the observed operators mentioned that it is about understanding the needs of the bridge team to be able to give them the “right” information in time.

Further, as mentioned above the operators listen to different VHF channels to get a better picture of what is happening in the area. The information on the radio is constantly checked with the information displayed on the screens showing the area. Whenever a vessel called, all observed operators directly focused their view on the calling vessel and if there were no incoming calls, the operators also followed the vessels which were establishing bridge-to-bridge communication.

Additionally to the information displayed in the system, each operator seemed to have special preferences on which areas to monitor more closely and what information in addition to draught, intention and destination was important for him. One operator mentioned that he always wants to know a vessel’s course and speed, another operator highlighted the information on upcoming pilotage as important and a third operator said that the CCTV cameras were an important source for him. Information on restrictions and ongoing bunkering operations in the area were also pointed out as useful.

Another technique observed to gain information richness was that one operator leaned back to get a better overview on all information displayed in front of him. It also helps to relax the eyes and to stay alert.
The operator comments on the working hours and says that it is sometimes hard to stay focused. According to his opinion no one can be alert 6 hours in one stretch.

As the communication, the enactment and the building of information richness seems to be rather individual and situation dependent. The traffic volume, the type of the traffic, the weather condition and the conditions in the VTS area were identified as crucial to determine which information is needed and when.

“The work and conditions are controlling you. There is no possibility to prepare”

4.3.7 Cooperation
During the two days of observation the main part of the cooperation was between the VTS operators and the officers of the watch and pilots on the vessels in the area. Further, all cooperation was conducted verbally mostly through either the VHF or the telephone. Additionally, the observed VTS operators also cooperated with the pilot-ordering service and the harbour personnel.

Not all cooperation was carried out in the same way. Although the operators all acted very professionally when contacting different vessels, the way the vessels were treated seemed to be depending on how well the operators felt understood by the bridge-team. When the operators felt that they were not clearly understood, the messages were repeated and message markers were used to underline the content.

4.3.8 Other
During the end of the observation the operators got more comfortable with my presence and commented more on what they personally identified as important for maritime safety and how they felt as part of the organization.

One operator mentioned that he was naive to think that a VTS operator actually cooperates with other actors. Especially pilots do not always react in a friendly way towards the information they get. It is hard to provide “the right information”, if one does not know what is expected.

Another comment was that the VTS area had been reduced since last January but that it seemed as if this reduction was a decision based on economical reasons without paying attention to the severe safety reduction.

“You want to make a difference but you do not really feel appreciated by the organization [SMA]”

Further, several operators mentioned that they felt that there is too little understanding for the actual work situation of a VTS operator resulting in more and more tasks that they are supposed to take care of. They mentioned that there is a need to understand that their main task should be the monitoring and informing of the traffic and that this is an important task which requires a high amount of awareness. Therefore it should be prioritized. This needs to be understood by the authorities and it should not end up in making even more tasks part of the job description of the VTS, e.g. ship reporting to the authorities.
5 Analysis

This chapter analyzes the results obtained in the data collection process. It connects the data with the research questions and the theoretical framework.

5.1 How do the various actors in the maritime domain define maritime safety and what do these definitions have in common?

The various actors all defined maritime safety differently. In general, there was no exact definition of the term maritime safety. It was more or less always seen as an umbrella term including several specific measures to improve the overall safety of the traffic. In the next paragraphs the results of the literature study and the interviews are summarized in short before the analysis of the definitions in relation with high reliability organization theory.

The IMO had no explicit definition on maritime safety, but there is the work of the Maritime Safety Committee which is related to what is stated in the SOLAS convention (“International Convention for the Safety of Life at Sea,” 1974). Therefore it is concluded that the definition of maritime safety is based on what is expressed in the convention. Concerning VTS, it is declared that it is a service contributing to the safety and efficiency of life at sea, the efficiency of navigation and the protection of the environment.

The IALA did not have any definition of maritime safety either, but there are references to the work of the IMO conducted by the Maritime Safety Committee on the homepage of the IALA. Further, a general definition of the term safety could be found. It defines safety as a condition regarding the guarantee of an intended purpose of a specific installation or process. The focus in this definition is on the equipment and processes with safety as condition of these measures. However, there is no reference, neither on how to achieve this condition nor on its connection with the actors, e.g. vessels or the VTS, included in the shipping domain.

The European Maritime Safety Agency, although emphasizing the fact that they assist the European Commission on developing legislation on maritime safety, did not have any explicit definition of this concept either. It was rather the case that maritime safety is defined implicitly through mentioning various measures to improve this specific type of safety. SafeSeaNet (SSN), a vessel traffic monitoring and information system, was pointed out as the main objective concerning maritime safety. In relation to this system the VTS was defined as a service improving the safety and efficiency of the vessel traffic and the protection of the environment, two concepts relating to what is stated in the SOLAS convention.

Similarly to the organizations above, the Swedish Transport Agency did not have any explicit definition of maritime safety. Maritime safety is seen as an umbrella term including all the measures, e.g. formulation of rules and regulations and the supervision of the vessels sailing in Swedish waters, which are supposed to be improved to achieve a high degree of safety for the maritime community. In connection with maritime safety, the VTS is just one part of the measures addressed by the STA. The VTS is seen as an information service monitoring the vessel traffic in a specific area, including assisting and informing the participating vessel to improve the safety and efficiency of the vessel traffic and the protection of the environment.
The Swedish Maritime Administration defined maritime safety as the combination of different measures, fairway design, pilotage and VTS in specific, with the goal to minimize incidents and accidents. The goal of maritime safety measures was defined as being cost-effective improving the safety as much as possible. The VTS was defined as being just one of these measures. As service it should be focused on informing the vessel traffic in a VTS area.

The Swedish Shipowners’ Association defined maritime safety as quality shipping regarding the compliance of vessels and crew to current rules and regulation and emphasized on the importance of working proactively to improve this specific type of safety. In the light of maritime safety, the SSA sees the VTS as an important service to the maritime community. It should therefore be the main organ of communication in a VTS area. However, to improve maritime safety the VTS should become more active through early intervention in the traffic to prevent incidents and accidents from happening in an early stage.

Lloyd’s Register, as a representative for the classification societies, did not have any information concerning maritime safety on their homepage. But through email contact with human factors specialists, maritime safety was defined as a quality of a system which arises between management, engineering and operations and is the extent to which these are free from danger to life, property and environment.

Of all actors above, only three had a definition of the concept of maritime safety and only one actor emphasized on safety being a quality arising between different parts of the system and of something which can exist to a certain extent, in the meaning of not being either there or not. In general, the actors defined maritime safety in accordance with what is stated in the SOLAS convention: the safety of life at sea, the efficiency and safety of navigation and the protection of the environment. Further, all actors focused on specific measures to improve maritime safety.

According to high reliability theory, safety is not a thing that is either there or not. It is rather the case that safety is a state which actively needs to be mediated between different levels of an organization (Rochlin, 1999). Only Lloyd’s Register identified this important aspect.

Further, as there are no explicit definitions of maritime safety, it is hard to promote this type of safety. The different actors define maritime safety as a collection of various measures, with every actor emphasizing on different measures as being essential.

Rochlin (1999) argues that safety is a culture rather than a certain system property. It can therefore only be achieved as a general commitment to norms, values, practices, expectancies and identities that all members share. In the maritime actors’ definitions no agreement on parts included in the concept of maritime safety can be found. There are no common expectancies, practices, norms and values. It is rather the case that each actor values different measures as important, e.g. SMA talks about the importance of fairway design while EMSA highlights SafeSeaNet, although the actors themselves said to be cooperating for the promotion of maritime safety. However, even if the actors have different competencies in the maritime community, for the promotion of maritime safety there should be a common understanding of this term.

Rochlin (1999) also highlights the importance of reflective and interactive learning. This fact is only highlighted by the SSA which tries to promote safety through financing research in the shipping
domain. In the case of the STA learning is supposed to take part through the cooperation with organization in the form of discussion groups and newsletters. But there was no indication on how much the STA actually tries to learn from the actors in the maritime domain. It seemed rather to be the case that the values, expectancies and procedures are imposed from above, not necessarily through reflective learning.

Finally, to be able for an organization to maintain a safe state, safety needs to be defined in the organizational and social settings (Rochlin, 1999). Only the SSA indicated an active engagement in defining maritime safety in the organizational and social settings in pointing out the importance of compliance of the vessels and crews to the current rules. All the other actors pointed towards measures of improvement, but none actually focused on the organizational and social settings in which maritime safety can arise.

5.2 How does the work of a VTS operator relate to the actors’ definitions of maritime safety?

The work of a VTS operator does not actually relate to the actors’ definition of maritime safety. Although VTS was named as one measure amongst others to promote maritime safety there did not seem to be a common understanding of how an operator works and of how his work relates to the concept of maritime safety. The VTS was identified as an information service to all vessels in the area and it was emphasized on the importance of communication.

As mentioned above, HRO theory stresses that shared norms, perceptions, values and expectations are essential for building a safety culture (La Porte, 1996). The definition of maritime safety by the actors showed that there are no such shared values that go further than the identification of maritime safety as being connected to what is stated in SOLAS chapter V, the safety of life at sea, safety and efficiency of navigation and the protection of the environment. However, there is just little or no concern in how this relates to the actual work conducted by a VTS operator.

Further, the operators themselves mentioned that they were not or only to a certain extent influenced in their work by any international guidelines and recommendations. This means that whatever is constituted by the IMO, STA, EMSA, IALA and SMA is nothing that is consciously present when a VTS operator conducts actions as part of his daily work. To promote a safety culture throughout an organization, Rochlin (1999) emphasizes the importance of mutual understanding as well as the need of shared knowledge and identities so that safe actions can arise in an organization. In the case of the VTS operators there seems to be little concern on the management level, constituted by the STA and the SMA, for how the operators actually work. Thus, their understanding of maritime safety and their definition does not match the daily work of an operator. This results in a situation where there is little or no shared knowledge between the operational level (the VTS operators) and the management (STA, SMA, EMSA, IMO, IALA).

Another fact that is highlighted by HRO theory is the need of communication for the sake of information richness. It arises in the communication between different levels in an organization (Weick, 1987). In the case of the VTS, the communication richness regarding the different actors is shaped by non-verbal communication. Written formal communiqués, such as guidelines, manuals, regulations, recommendations and other documents, are stated. As there is no additional verbal communication between the actors and the VTS operators, rather than having a positive impact, the
communiqués seem to construct a framework which makes the work of an operator ineffective. More and more mandatory tasks, such as the mandatory vessel reporting to the authorities, are stated in these documents and become part of the daily work of a VTS operator. The operators themselves mentioned concerns on how this has a negative impact on their ability to conduct traffic monitoring and information service as their concentration is drawn towards these other tasks. Instead of giving information to promote maritime safety, there is a decreasing capacity of being able to react towards the vessels’ needs.

Thus, rather than defining maritime safety as culture and mediating it throughout the maritime domain in relation to the VTS and an operator’s work, each actor makes up his own goal-oriented safety definition which has little or no concern for the operator’s work. Therefore it becomes hard to construct a common understanding for maritime safety and for how it can be promoted efficiently.

### 5.3 How do the VTS operators define maritime safety?

In general, the operators defined maritime safety similar to the SOLAS convention. It was mentioned to be the safety of life at sea, the environment and the vessel traffic. The general framework for the operators’ work was defined to be based on the SOLAS convention as well as regulations and rules constituted by the IMO.

However, besides the general definition of maritime safety being the safety of life at sea, the protection of the environment and the safety of the vessel traffic, it was defined as a property based on contextual factors such as equipment used to provide VTS, the traffic volume and specific actions performed to promote it in specific situations.

Further, the operators also highlighted that maritime safety is split into two parts for them; one part is the promotion of maritime safety as shore-based service, the other part consists of the working routines on board a vessel. Especially the compliance to current rules was pointed out as problematic for maritime safety today. This shows the deep understanding the VTS operators have gained through multiple years as both active seafarers and operators onshore.

Finally, in contrast to the actors’ definitions above, risks to maritime safety were identified while defining the overall concept. Especially language deficits regarding navigational English and fatigue were highlighted in the interviews. Further, it was also mentioned that the overall competency of the bridge teams seemed to have decreased. According to the VTS operators this is mainly due to lowering the demands on the level of education of officers on the bridge.

The definition of maritime safety made by the VTS operators shows several aspects which are stressed by high reliability organization theory. First of all, the VTS operators, although working at two different VTS centres, identified shared perceptions, norms and values in their definition of maritime safety. According to La Porte (1996) sharing perceptions, norms and values can be seen as an indicator for a safety culture build in an organization. In the case of the VTS operators, all operators shared the basic concepts which they identified as part of maritime safety; the safety of navigation, safety of life at sea and the protection of the environment. They further shared the perception that the competence of the bridge teams as well as the knowledge of navigational English had decreased through the past year and identified this as a threat to the overall safety for the vessel traffic. Further, the compliance to current rules and regulations was named to be a corner stone for maritime safety. This reflects shared norms and values concerning the navigation of a vessel and the
overall behaviour a seafarer should follow. Therefore, these shared perceptions, norms and values concerning maritime safety can be identified as a certain culture which is present in and influences the daily work of an operator.

Further, through the definition of maritime safety by the VTS operators, safety becomes connected to an operational level on which human actions are identified as being safe or unsafe by the operators themselves. Rochlin (1999) sees this as an indication for a safety culture implemented on a social level in an organization. The operators identify behaviour of different vessels as being safe or unsafe and react upon their own definition of maritime safety.

The emphasis on the importance of the context for the definition indicates further that safety is a system state which created actively by the VTS operators. Leveson et al. (2009) point out that one characteristic of a HRO is that workers actually invent courses of action dependent on the context to be able to maintain safety. This is exactly what the operators emphasize when naming the contextual dependency of the definition of maritime safety. Based on the technology at hand, the traffic volume and the overall situation, safety is created actively.

5.4 How do VTS operators promote maritime safety?
In contrast to the actors’ definition of maritime safety, the definition of maritime safety stated by the VTS operators is highly connected to the work that they conduct daily. Maritime safety is promoted through construction of the safety as part of a VTS operator’s daily work.

5.4.1 Reliability as Non-Event
VTS operators base their definition of maritime safety on the context events occur in. As shown in the observation, they define a situation as being safe through evaluating the traffic picture and the other information sources displayed in the decision support system. As the information differs depending on the contextual parameters, such as traffic volume, personal preferences of specific information sources (e.g. choice of radio channel, choice of CCTV camera picture), the input for the decision making is dynamic. Although the input is dynamic, the output is the same. Maritime safety is the output constructed by the operator through the evaluation of the dynamic information input.

This can be identified as what Weick (1987) defines as characteristic for reliability as a non-event in high reliability organizations. As observed, the operators produce a constant output, the absence of accidents and incidents, a fluent vessel traffic movement and a safe passage for every vessel in the area, based on a dynamic information input.

Although reliability as non-event is an important characteristic when talking about safety in high reliability organizations, it also inherits the risk of thinking that everything is normal or safe as the output is constant (Weick, 1987). During the observations there was low to medium traffic level. The operators were paying attention to how the traffic developed and acted on that, e.g. contacting bridge teams, pilots and harbour operational staff. However, one operator mentioned that it is hard to be alert for six hours in a row. It can happen that one gets less aware as the time proceeds and the traffic flows. As the traffic is moving fluently and no incidents or accidents are happening, the output of the system is constant giving the impression that there is nothing to specially pay attention to leading to a situation where an operator might miss an event which can result in an incident or accident disrupting the constant output.
5.4.2  Requisite Variety of the “Controller”
In the Vessel Traffic Service domain maritime safety is also defined based on the individual background of the operator. Having worked as an active seafarer, VTS operators emphasized that a lot of their actions are influenced by their former work experience.

As mentioned above Weick (1987) pointed out that the requisite variety of a controller is especially important for high reliability organizations as they work with complex technologies. In the VTS domain the controller is defined as the VTS operator operating a complex decision support system in which all information available is presented. The variety is constructed by the background of the operator. Depending on his background as an active seafarer and the experience as a VTS operator, the variety differs between the individuals, expressing itself in how they interact with the traffic.

In the observation the operators followed standard procedures, but they all had their own way of interacting with the traffic. One operator focused on facilitating the work of the pilots by informing vessels in the area on setting a specific course. Another operator mentioned that he was paying more attention to certain parts of a voyage of a vessel based on his own experiences as an officer on watch. A third operator highlighted that the information that he usually transmits to a vessel is based on what he would like to know if he was the officer on watch.

As the requisite variety of the operators differs, so does the way they recognize situations and solve problems (Weick, 1987). During the observation, all operators emphasized different pieces information as essential for building up an understanding of the situation.

5.4.3  Enactment of Reliability
According to Weick (1987), information richness is important to the requisite variety of an operator. As mentioned earlier, richness of information is built up through the interaction of an operator within the organization and with the outside world. VTS operators use not only the information presented in the technical system, but base much of their work on what they learn through the interaction with various actors inside and outside of the VTS.

As the operators changed between the shifts, it could be observed that they shortly briefed each other on all occurrences in the area, as well as on what is needed to be paid attention to.

*Two operators are shifting. The VTS operator ending his shift points at different areas on the screens which display the area. He talks at the same time “This one is sailing really slow”. Then he points at a vessel in an anchorage area “You can keep an eye on this one”*

The operators use the overlapping 30 minutes of their shifts to inform each other on what is going on in the area. Through this they build up information richness based on the information that is inside the organization. However, to be able to create an accurate situational assessment, there is also the need to interact with the vessels in the area, the harbour operational staff, the pilots etc. The interaction mainly takes place via the VHF. VTS operators ask for information and listen to ongoing conversations on the radio to build up a better knowledge on the environment and how it might
develop in the near future. Reliability in the case of the VTS is thereby enacted on an individual level by a VTS operator through information gathering.
6 Discussion

This chapter discusses the theoretical framework, the methodology and the results of this thesis. Further, suggestions for future research are presented.

6.1 General discussion

This study was an explorative study with focus on how maritime safety is constructed in the Vessel Traffic Service domain. Four research questions were used as a starting point for this thesis.

- How do the various actors in the maritime domain define maritime safety and what do these definitions have in common?
- How does the work of a VTS operator relate to the actors’ definitions of maritime safety?
- How do VTS operators define maritime safety?
- How do VTS operators promote maritime safety?

The results of the study indicate that maritime safety does not have a general definition in the maritime domain. It is rather the case that each organization has its own definition of maritime safety. These definitions have been analyzed by applying high reliability organization theory to see if the various understandings of what maritime safety is related to the work of VTS operators. The VTS is a service implemented to promote safety, but can this happen if there are so many different notions on what safety is and how it should be promoted?

Maritime safety as a concept is not successfully promoted throughout the maritime domain. This is mainly based on the fact that there is no common understanding of what is included in this concept. For VTS operators, maritime safety is constructed as part of their day-to-day work. It is bound to the situation and based on interaction with actors actively participating, such as vessels and pilots, in the VTS area. Only one operator saw his work connected to the administrative body. For the various organizational actors studied in this thesis, maritime safety is defined as an umbrella term including concrete measures, such as traffic separation schemes or fairway design. These two notions of maritime safety create a gap between the organizations working to constitute maritime safety and those who actually promote it on a day-to-day basis.

Much organizational research named in the theoretical framework indicates that safety is a culture that needs to arise through communication between various levels of an organization. Safety is about interrelated learning and about understanding the meaning of each actor in this domain for the overall safety.

Thus, to be able to successfully promote maritime safety, there is the need to communicate and cooperate more to derive a common understanding of the term maritime safety including defining what each actor can do to improve the overall safety in the maritime domain. The gap between the operational level (VTS operators) and the management (the organizational actors) needs to be overcome through building trust in each others’ competencies.
6.2 Theoretical framework
As a theoretical framework high reliability theory was chosen as it offers insights on how safety is constructed in organizations with high hazardous potential. This perspective is based on the notion of safety and accidents being systemic in the meaning of being non-linear and having several causes which can influence the upcoming and outcome of both accidents and safety. High reliability organization theory was seen as well-suited as it is based on results obtained from studies in similar domains, such as the aviation domain. Additionally, this perspective offers insights on how safety is arising as a culture with focus on common norms, values and practices which need to be mediated between the various levels of an organization. Finally, this perspective also offers an explanation on how the individual background and individual way of conducting the daily work can have an impact on the reliability of an organization.

However, the theoretical framework outlined above has some critical aspects which should be discussed. Although HRO seemed well-suited for this thesis, one should keep in mind that this theoretical framework is very limited. HRO theory has been proven to only be applicable to organizations which have safety as a main objective or as reason for their existence (Leveson et al., 2009). It further does not really offer any kind of solution for how to effectively mitigate the risk for accidents.

6.3 Methodology
In this section of this chapter, I would like to discuss the methodology chosen for the data collection of this thesis.

6.3.1 Reliability and validity of this study
Reliability and validity are concepts used to validate and evaluate scientific work. Reliability concerns the question of how reliable the results of a study are. Are the results going to be the same if the study is repeated? (Bryman, 2002) It refers to the stability of the results over time or repeated measures and is usually established by replication (Davis, 1995).

As this study was designed as a qualitative study and used ethnographic methods, it does not have a high degree of reliability in the traditional sense. The VTS centre is a complex environment and there are many factors which could have had an impact on how the VTS operators work and think about their work. Not only facing a high variation in the traffic density and type of traffic, but also working in a VTS centre with a yet-to-be-decided future might have influenced the individuals that took part in the observation and interviews in the study. Therefore it is not likely that this study would derive exactly the same results if it was repeated. With a low repeatability, the reliability is low, too.

Validity is concerned with the connection between results, the tools and measurements used to derive results. Are the results valid in the sense that they measure what they were supposed to measure? Can the results be applied on peoples’ everyday lives and their social environment? Can results be generalized? Those are questions that one poses when trying to analyze a study’s validity (Bryman, 2002).

There are different types of validity. Most central in scientific research are internal and external validity. Internal validity is concerned with the measurements made in a study. A study has a high degree of internal validity if it can be ruled out that any other factors could have influenced the results. It measures just what is supposed to be measured and there is no other explanation for the
outcome. External validity can be divided into two sorts of validity, population and ecological validity (Lützhöft, Nyce & Petersen, 2009).

Population validity is concerned with posing the questions of generalization (Snow as cited by Lützhöft, Nyce & Petersen, 2009), while ecological validity deals with the question if the results of a study are applicable to peoples’ everyday lives and their social environment. It questions if the instruments that were used to collect the data can resemble the individuals’ everyday routines, attitudes, values etc. (Bryman, 2002).

In this study there are several issues that can be discussed concerning validity. The internal validity of the study is rather low. The results have been derived by the use of ethnographic methods. As stated above, the use of those specific types of methods always means certain subjectivity and it cannot be ruled out that other factors than those presented in this thesis have an impact on how VTS operators feel, think and act upon the concept of maritime safety. The study had a descriptive character and was meant to be explorative. The results therefore can never be seen as absolute.

Concerning external validity, it is rather hard to define if this study has a high or low degree of validity. As the sample was small, eight VTS operators from two different VTS centres, the results can probably not be generalized to a larger population. The operators act based on local knowledge and it is hard to derive results which are applicable outside of the context they were collected in. Therefore the population validity is rather low. However, the ecological validity of this study is high. It was tried to get socially and physically close to the natural working environment and working routines of VTS operators by observing them during a day shift. The operators were doing their job under normal conditions. There was low to medium traffic and none of the operators mentioned something unusual. Further, the data from the observation was completed by interview data from informal interviews conducted during the observation. This was done to prevent misinterpretation of an action or activity.

But if the population validity is low and the ecological validity is high, what does it say about the external validity in general? And if the internal validity and reliability of this study was rather low, what does this for the research’s scientific value? Is it not scientific at all?

Grounded in a hermeneutic approach Lützhöft, Nyce & Petersen (2009) suggest four concepts, credibility, transferability, dependability and confirmability that might be better suited for evaluating the quality of ethnographic research than reliability and validity which are derived from quantitative methods. As this research is based on ethnographic methods, I am proposing to use these categories instead of using the traditional concepts derived from quantitative research.

6.3.2 Credibility

Credibility is close to what is defined as internal validity. It regards the relation between the views of the respondents and the reconstructions and analyses of the researcher. A high degree of credibility can be achieved through triangulation of data sources, long-term engagement in a research environment and persistent observation (Lützhöft, Nyce & Petersen, 2009). This study has tried to triangulate the data through the use of different methods. A literature study, interviews with both operators and actors in the maritime sector and an observation were conducted. Further, participation in other research projects was used to build up a deeper background knowledge and...
understanding for the VTS domain. In comparison to the rather low traditional concept of internal validity, the credibility of this study and the results derived is rather high.

6.3.3 Transferability
Transferability is comparable to external validity. It is concerned with the generalization of the results across the target population, settings, subjects and time (Meister, 1991 as cited Lützhöft, Nyce & Petersen, 2009). In ethnographic research the transferability is achieved by thick description. Thick descriptions are based on detailed and context-sensitive field-notes. Through this type of description it is not only possible to understand the settings in which the research took part, but also the situations the participants experienced and why they experienced them the way they did (Lützhöft, Nyce & Petersen, 2009). This study provides detailed descriptions by combining interviews with observations. The results presented should provide insights in how the informants themselves experience the action and activities conducted during their daily work. Therefore there is a certain degree of transferability as it is described above.

6.3.4 Dependability
Dependability refers to reliability in qualitative research. It regards the documentation of the research process and the possibility to track and reconstruct how results were derived. To achieve a high degree of dependability, detailed documentations and research audits can be used (Lützhöft, Nyce & Petersen, 2009). Research audits can be the actual respondents or other experts. The audits offer a chance to test one’s interpretation of a situation against those of the audits and create a way to become aware of how those interpretations can differ. In this study, different audits were used. The observations were discussed with a former VTS operator and his critical comments were taken into account while evaluating the field notes taken. For the interviews, the interviewees were used as auditors.

6.3.5 Confirmability
Confirmability addresses the question of objectivity. It is achieved when it can be argued that data, interpretation and results are derived from the context and the respondents (Fishman as cited by Lützhöft, Nyce & Petersen, 2009), not only based on the researcher’s assumptions. Again auditors can be used to enhance the degree of confirmability. In this study, as mentioned above, several auditors were used to discuss and check upon the results and to give their interpretation. Further, in connection with the observation, the participants themselves were continuously asked on what they were doing and why. This also had an impact on the confirmability of this study as the recorded results resemble their opinion on actions and activities, not mine.

An ethnographic approach to a domain is always subjective in some way. The researcher chooses areas of interest and notes down some things as important and some as not so important. Other facts might even be left out (Emerson, Fretz, Shaw, 1995).

The following paragraphs are going to discuss each method used for data gathering regarding advantages and disadvantages as well as problems faced during the data collection.

6.3.6 Literature study
A literature study is often a starting point for a research project. It can help to highlight areas of interest as well as it can assist while developing a research design. Further, a literature study can be used to provide an overview on studies carried out in the research area (Robson, 2007).
For this research, a literature study was used to gain a broad background knowledge on the VTS and on the concept of maritime safety. Different homepages, guidelines, recommendations and information brochures were studied. There were no problems with finding information and the literature provided general background that helped me to highlight certain areas of interest for this study.

But one problem I had to face was that instead of getting closer and closer to a definition of maritime safety by studying various sources, I got carried away and spent more time than planned on this part of the study. The information on how different actors work with the concept of maritime safety was extensive, but no actor had actually defined the term. It was rather the case that the actors focused on specific measures, such as the implementation of SafeSeaNet, instead of dealing with maritime safety on a defining level. Although maritime safety was part of many pieces of the information, there was no real definition leaving me with the interpretation on what is included in this concept.

Instead of finding explicit definitions it became a task itself to interpret what the various guidelines, recommendations and information brochures actually meant when mentioning maritime safety, safety and efficiency of navigation etc. Therefore all information presented is somehow an interpretation I made of the sources I found. Without a sufficient background in law I may have misinterpreted some sources and did not value others enough.

6.3.7 Interviews
The interviews conducted were semi-structured and were conducted in different contexts. They were based on an interview guide but the order of the questions varied depending on the respondent. As Bryman (2002) points out, this type of interview gives the researcher the chance to construct an interview guide which covers several topics in detail. Another advantage is the flexibility of such interviews. As they follow a rough interview guide the researcher is free to explore the answer of the interviewee through more detailed follow-up questions.

Further, in semi-structured interviews, the flexibility of the researcher gives the respondent the chance to guide and highlight areas of interest. This was especially important when it came to the triangulation of the data. Through the interviews, I could check if what I noted and interpreted made sense. Further, through the use of follow-up questions it was possible for me to ask more specific questions to clear up misunderstandings and to gain a deeper understanding for the respondents’ perspective on the subject.

As the questions were open-ended all respondents were free to answer as much or as little as they wanted. This is another advantage as it can lead to a rich data collection (Breakwell, 1995). But that is also a problem with interviewing as a method for scientific research as it relies on the willingness of the respondent to give complete and accurate answers to the questions asked (Breakwell, 1995). There are various factors that can influence an interviewee not to answer completely accurate, e.g. in the case that he/she is ashamed. Therefore both interviews and observations were used to get insights on how maritime safety relates to the daily work of VTS operators.

As mentioned earlier, all interviews were transcribed verbatim before the analysis. Emerson, Fretz and Shaw (1995) stress that a transcription is not only a tool. It is the first step of the analysis as it involves both analytical and interpretive decisions when deciding what and how to transcribe. In the case of these interviews, the transcriptions were verbatim and not on a very detailed level. They
simply depicted what the interviewees had answered. But still, through the transcription and the translation some information might have got lost as I did not reflect upon the transcript in detail, but rather used it to summarize the interviewees’ answers.

6.3.8 Observation

Similar to the method of interviewing, using an observation for gathering data in this study had both advantages and disadvantages.

The major strength of observations is that they are direct; there is no delay between recording and the occurrence of a phenomenon (Wilkinson, 1995). Further, they can be used to observe a wide range of situations and can therefore provide rich qualitative data, making it possible to analyze and understand complex situations and relationships (Robson, 2007). In the case of my observation, I had the chance to follow two VTS operators through 10 hours on two days. That made it possible for me to gain insights on the work that VTS operators do daily. Through the questions asked I could understand how the operators experience their work in relation to the concept of maritime safety and what actions they carry out to maintain a level of safety. This would not have been possible to achieve through any other data gathering method.

Further, by being an outsider without any maritime background it was possible for me, to react sensitively towards the environment and actions taking part in a way that I might have seen things that would have been invisible for me otherwise. Forsythe (1999) points out that the detection of tacit knowledge is especially hard for insiders as it is invisible to them. It is about comparing the inside and outside views of events and processes. In the case of this study, comparing the inside and outside views was much about trying to match what informants said with what they did.

But being an outsider also had several disadvantages. Although I have been building up a basic knowledge on navigation, navigational charts, radio communication and the VTS as such during six months, it was still obvious that some parts were missing for a complete understanding of the situation. Therefore all observations were influenced by my rather subjective and sometimes naive way of seeing and describing and I was also struggling to find the “right” question to ask. In the maritime domain actions are based on long working experience and when asked why a certain action was performed, not all operators were able to verbalize their deep rooted tacit knowledge. It might be the case that a researcher with a maritime background would have analyzed the collected data in a different way or would have asked other questions.

Further, the closed communities and environment such as a VTS are restricted in their contact to outsiders. It is important to obtain the informants’ trust so that they act naturally. Although everybody was welcoming, I felt as if the VTS operators did not actual act normally but rather more “correct” on the first day of observation. Wilkinson (1995) describes this phenomenon as the observer effect or reactivity. People are aware of that they are being studied and their behaviour is therefore influenced by the presence of an observer. It might happen that they correct their behaviour or act less controversially in relation to current procedures at the VTS. It takes time before a person gets comfortable with being observed and asked questions. It was also the case that I sometimes felt like being just another person there to evaluate the actual performance rather than building up an understanding for how work is done and how working routines differ. The biggest change for me came on day two when the VTS operators actually started talking about how they feel concerning maritime safety as part of their daily job and in the light of the future changes to come.
“In the beginning I was actually thinking that I would make a difference, but it is hard if you do not feel appreciated by the organization” (VTS operator during observation)

Finally, there was the choice of not recording data. All data was collected by asking contextual questions such as “What are you doing now? Why are you doing this?” But there were no actual recordings in form of video or audio tapes. The answers and observations were collected by making notes. Therefore parts of the information might have got lost.

6.4 Results
As the methodology and the theoretical framework of this thesis, the results obtained in the study can be discussed.

This study did not aim in presenting the “truth”, but multiple truths on how VTS operators work, how they define maritime safety and to which extent this matches the definitions of this specific type of safety of organizational actors in the maritime domain. However, the observation and the interviews were conducted with Swedish VTS operators and representatives. There is a possibility that the outcome might be different if the study would have been conducted in other settings. This thesis highlights how safety is bound to the context and the culture around it. Other settings might therefore have provided different insights.

Further, the situation in which the study was conducted might have had an impact on its outcome. Currently the VTS as a service is undergoing extensive changes. The VTS West Coast is going to be moved to Södertälje. VTS in Sweden is going to be centralized. During the time I observed operators at work and interviewed them, they already knew that there were changes ahead, but the decision on what would happen to the VTS West Coast had not been made, yet. This situation might have had a strong impact on the operators’ answers and way of conducting their work.

However, the results of this study offer new insights on how VTS operators work. Further, it highlights the differences and deficiencies in the definition of the term maritime safety amongst organizational actors in the maritime domain and shows to what extent these definitions differ and what they have in common. It further emphasizes on safety construction in the VTS domain and proposes a theoretical framework which can be used to get a better understanding of maritime safety from the perspective of an operator.

6.5 Further research
This study aimed to gain insights on how VTS operators work and on how definitions of maritime safety relate to the daily work of the operators. The results presented above show that there is the need to conduct further research to be able to frame maritime safety as a concept between all actors in the maritime community.

First of all, to build up a general understanding for maritime safety and for how it is promoted in the maritime domain, there is also the need to study the “bridge” perspective. This study only focused on the VTS and organizational actors such as SMA, SSA, STA, IMO etc. As the VTS operators emphasized that they are promoting maritime safety through cooperation with the vessels in the area, there is the need to understand how bridge teams define maritime safety and promote it. A possible study could be an ethnographic field study involving observations of and interviews with members of bridge teams on vessels in a VTS area.
Further, it would also be interesting to study the VTS domain more thoroughly through an ethnographic field study with more time spent at the site. Through studying VTS operators at work for a longer time, there would be a possibility of getting a better understanding for how safety is enacted by the operators. Such a study could also gain more insights on how VTS operators make decisions. When is a situation considered to be safe? When is an operator acting proactively?

Finally, another area interesting for future research would be to monitor the consequences of the centralization of VTS in Sweden. Through the centralization of the service, VTS operators will monitor areas which are located far from their worksite. Does this have any effect on how VTS operators work? What possibilities and problems arise now that the VTS is centralized?
7 Conclusions

This chapter presents the overall conclusions drawn from this study.

7.1 General conclusions

The study’s aim was to explore the VTS domain and obtain insights on how VTS operators work and how safety is constructed in this specific domain. VTS operators and representatives of organizations in the maritime domain were interviewed. Further, an observation was conducted.

The organizational actors did not have a common definition of the term maritime safety. It was rather used as an umbrella term covering several measures to improve maritime safety. The VTS was seen as just one of those measures.

In contrast to the organizational actors, VTS operators defined safety as something individual and context-dependent. Safety is experienced and constructed individually by each VTS operator. His background, education and expert knowledge of the area and the decision support system provide the operator with all necessary information to validate the safety of the current situation presented to him. Safety therefore becomes a dynamic condition which is promoted by the interaction between the VTS operator and other actors. The VTS operators themselves identified all vessels in the VTS area as well as pilots, harbour operational staff and the pilot ordering service as the most important partners for cooperation.

Therefore it is concluded that there is a gap between what various shipping domain organizational actors and what VTS operators understand and define as maritime safety. To increase the overall safety in the maritime domain, there is the need to overcome this gap through building up common values, norms and identities. Mutual understanding and interaction between the operational staff (the VTS operators) and the “management” (SMA, STA, SSA etc.) need to be improved. Instead of having several definitions of maritime safety, there should be one definition which can capture the fact of safety being a dynamic condition which is shaped by the enactment of the reliability through, in this case, the VTS operators.

The VTS as service to the maritime community should be seen as the subject in the construction and promotion of maritime safety, not as just an object, or one amongst many measures.
8 References


**Internet sources**


**Guidelines, regulations, recommendations and directives**

**European Union:**


**International Association of Marine Aids to Navigation and Lighthouse Authorities (IALA):**


**International Maritime Organization (IMO):**


Appendix A

Interview guide for the representatives

- How does XX (name of the organization) define maritime safety?
- What does XX (name of the organization) do to promote maritime safety?
- Who does XX (name of the organization) cooperate with to promote maritime safety?
- How can maritime safety be improved in the future?
- What role does the Vessel Traffic Service have for maritime safety?
- What is the Vessel Traffic Service expected to do as service for the maritime sector?
Appendix B

Interview guide for VTS operators

- How do you define maritime safety?
- What do you do to promote maritime safety?
- Who do you cooperate with to promote maritime safety?
- How is your work influenced by international recommendations and guidelines?
- How can maritime safety be improved in the light of the future?
Appendix C

Observation guide

A typical passage
What is included in a passage through the VTS area?
When does the operator call for the vessel? Which information is asked for?
How long does each contact take?
Are all vessels treated the same way?

Communication
What means (e.g. telephone, VHF, mobile phone, internet/mail) are used for communication?
When is the communication public and when private?
What type of information is transmitted through different means of communication?
Which channels on the VHF are used to talk to other actors?
Are there differences in the way of communicating with other?

Enactment – Information Richness
Which information does the operator use? Which information does he want to have and why?
What does an operator do to get more information than what is presented in the system?
How is information richness created? When is it too much or too little information?
What information is paid attention to?

Cooperation
Who the operator cooperate with?
Who is he talking to?
How long does the cooperation last?
Are there other ways of cooperating besides verbal interaction?
Is the cooperation different depending on the actor?

Other
How does an operator define an incident and an accident?
What is a constant safety?
How does an operator decide if a situation is safe or not?