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Oil spill preparedness in Sweden : prevention, planning, and response for large accidents

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OIL SPILL PREPAREDNESS IN SWEDEN

Prevention, planning, and response for large accidents

By

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Sweden

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By failing to prepare, you are preparing to fail.

- Benjamin Franklin

Preface

This dissertation is submitted for the degree of Doctor of Philosophy in Maritime Affairs, Maritime Environmental Management at the World Maritime University in Malmö, Sweden. It has been conducted under the supervision of Professor Olof Lindén and Professor Lawrence Hildebrand at the World Maritime University from 2009 to 2015.

This dissertation consists of original, unpublished, and independent research by the author, except where acknowledgements and references are made to other sources. The research has been conducted primarily during the Baltic Master II and the Baltic Maritime Science Park Oil Spill Forum projects.

The author was the coordinator for Work Package 3 - Improved land-based response capacity to oil spills at sea, in the Baltic Master II project. Work Package 3 developed, updated and tested oil spill contingency plans, updated the Swedish environmental sensitivity atlas, and developed guidelines on integrating contingency planning in coastal management. The European Union Baltic Sea Region programme funded Baltic Master II from 2009 to 2012.

The author was responsible for the Baltic Maritime Science Park Oil Spill Forum. The Oil Spill Forum maintained a database of oil spill projects and the @BMSPoil Twitter account for oil spill news for the Baltic Sea Region, as well as conducted workshops to develop new oil spill projects. The Swedish Institute funded the Oil Spill Forum from 2012 to 2013 and the Swedish Civil Contingencies Agency from 2014 to 2015.

Declaration

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

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

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Abstract

Title of Dissertation: **Oil spill preparedness in Sweden - Prevention, planning, and response for large accidents**

Degree: **PhD**

This dissertation has analysed the Swedish oil spill preparedness between 2010 and 2015 by examining management, prevention, planning and response, and compared it to international practices. The study is based on analysis of available data, surveys administered to the coastal County Administrative Boards and municipalities, and interviews with the national oil spill experts.

Oil spills can cause significant acute damage to the environment. Sweden has a long coastline with intense shipping traffic. This suggests a high risk of a large oil spill occurring, but no oil spill over 1,200 tonnes has affected the Swedish territorial waters or Exclusive Economic Zone.

The findings show that the Swedish Coast Guard, the Swedish Civil Contingencies Agency, the Oil Spill Depots, the Swedish Agency for Water and Marine Management, and the Oil Spill Advisory Service are central organisations to national oil spill preparedness. All relevant international conventions have been ratified and implemented, excepting the OPRC Convention requirement to have a National Contingency Plan for oil spills. Oil spill contingency plans exist in 79% of the coastal municipalities. However, only 60% of the coastal municipalities have conducted oil spill exercises within the last 5 years. Requirements to follow up evaluation recommendations were only present in 18% of the 11 real spill and exercises analysed. It is concluded, that in some respects, the structures of Swedish preparedness to handle the impact of a major oil spill somewhere on its coastline could prove to be inadequate. Despite this, Swedish oil spill preparedness is shown to be equivalent to most neighbouring countries.

This dissertation establishes the strengths and weaknesses of the Swedish oil spill preparedness regime and calls for further development. The benefits of maintaining and improving the current level of preparedness far outweigh the effort, but will only be evident when a large oil spill occurs.

Keywords:
Oil spills, Preparedness, Management, Contingency planning, Sweden

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This dissertation is the result of a long and interesting journey. I have become a much better professional and academic, made many new friends and connections, and had opportunities to travel to interesting places to work and attend conferences.

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Biography

Jonas Pålsson graduated in marine biology from Lund University in Sweden 2005, specialising in marine environmental research and sensory biology. He worked with water sampling for ALcontrol Laboratories in Sweden and Denmark from 2007 to 2009. From 2009 to 2015, he was a PhD student while simultaneously working as a Research Assistant in the Maritime Environmental Research Group at the World Maritime University in Malmö in Sweden. In addition to the work at the World Maritime University, he has worked for the United Nations Environment Programme's Post Conflict and Disaster Management branch on the project Environmental Assessment of Ogoniland from 2010 to 2011.

List of Publications

Published and unpublished work produced during the PhD, but not directly included in the dissertation.

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List of Abbreviations

Abbreviation	Explanation
AGP	ARPEL Governance Project.
AIS	Automatic Identification System, an automatic tracking system used on ships.
ANOVA	Analysis of Variance, a common statistical test comparing variable means.
API	American Petroleum Institute.
ARCHOIL	Management of onshore clean-up operations of oil spills in archipelagos, an EU project.
Arctic Agreement	Agreement on Cooperation on Marine Oil Pollution Preparedness and Response in the Arctic, an Arctic Council agreement.
ARPEL	A non-profit association gathering oil, gas and biofuels sector companies and institutions in Latin America and the Caribbean.
ASEAN	Association of Southeast Asian Nations.
ASEAN-OSPAR Project	Project on Oil Spill Preparedness and Response in the ASEAN Seas Area.
BALEX DELTA	HELCOM annual oil spill exercise.
Baltic Master II	EU project to improve the on-land response capacity to oil spills in the Baltic Sea as well as to enhance the prevention of pollution from maritime transport.
BMSP	Baltic Maritime Science Park, an innovation and communication platform for maritime issues in the Baltic Sea Region.
BOILEX	The first international Baltic Sea oil spill exercise that included onshore response, conducted in 2011.
Bonn Agreement	Agreement for cooperation in dealing with pollution of the North Sea by oil and other harmful substances.
BONNEX	Bonn Agreement annual oil spill exercise.
BP	Originally British Petroleum, an oil company.
BRISK	Sub-regional risk of spill of oil and hazardous substances in the Baltic Sea, a HELCOM project.
BSAP	HELCOM Baltic Sea Action Plan.
BSPA	Baltic Sea Protected Areas, HELCOM Marine Protected Areas.
Bunker Convention	International Convention on Civil Liability for Bunker Oil Pollution Damage.
CABs	County Administrative Boards are the Swedish Government's regional authorities, tasked with overseeing national policies and goals by coordinating regional activities and issuing permits.
CCA	Clean Caribbean and Americas, an oil spill response company.
CLC Convention	International Convention on Civil Liability for Oil Pollution Damage.
CleanSeaNet	EMSA satellite surveillance system for marine pollution.
CNDS	Centre for Natural Disaster Science, a science platform in Sweden.
Copenhagen Agreement	Nordic Agreement on Cooperation regarding Pollution at Sea from Oil and Other Substances.
CPA	Crisis Preparedness Agency, a disused Swedish agency that merged with other agencies to become MSB.
EEZ	Exclusive Economic Zone.
EMSA	European Maritime Safety Agency, an EU agency.
EnSaCo	EU project aimed to reduce negative environmental and socio-economic impacts of an oil spill accident through rapid and efficient shoreline oil spill response.
EPA	Environmental Protection Agency, responsible for the Swedish environment through regulations, funding support, and raising environmental awareness and responsibility.
EPPR	Emergency Prevention, Preparedness and Response Working Group of the Arctic Council.
EU	European Union.
EUSBSR	EU Strategy for the Baltic Sea Region.
FOI	Totalförsvarets forskningsinstitut, the Swedish Defence University.
FOSC	Federal On-Scene Commander, a command position in the ICS system.
FRG	Voluntary Resource Group.
FSHex13	Fu Shan Hai Exercise 2013.
FUND Convention	International Convention on the Establishment of an International Fund for Compensation for Oil Pollution Damage.
GI	Global Initiative, an umbrella programme for IMO and IPIECA, working to assist countries in developing national structures and capability for oil spill preparedness and response.
GI WACAF	Global Initiative for West, Central and Southern Africa.
gt	Gross tonnage, measurement of the internal volume of a ship.
Haveriekommando	Central Command for Maritime Emergencies, responsible for oil spill preparedness in

	Germany.
HELCOM	Helsinki Commission, the Helsinki Convention secretariat.
HELCOM RESPONSE	The marine pollution response working group of HELCOM.
HELCOM SHORE	The shoreline pollution response working group of HELCOM.
Helsinki Convention	Convention on the Protection of the Marine Environment of the Baltic Sea Area.
HNS	Hazardous and Noxious Substances.
ICS	Incident Command System, a standardised approach to command, control, and coordination to handle complex emergency responses, used primarily in the United States.
IFOs	Intermediate Fuel Oils, a type of fuel for ships.
IMO	The International Maritime Organization, the UN agency for maritime affairs, responsible for international maritime rules and conventions.
IMS	Incident Management System, a function-based management structure.
Intervention Convention	International Convention Relating to Intervention on the High Seas in Cases of Oil Pollution Casualties.
IOPC Fund	International Oil Pollution Compensation Fund.
IOSC	International Oil Spill Conference, the world's largest oil spill conference.
IPIECA	The International Petroleum Industry Environmental Conservation Association, the global oil and gas industry association for environmental and social issues.
ISO	International Organization for Standardization.
ITOPF	The International Tanker Owners Pollution Federation, a non-profit industry funded expert group on oil and HNS spills, providing services in spill response, claims analysis, damage assessment, contingency planning, training, and information.
IUCN	International Union for Conservation of Nature, an environmental non-profit organisation.
IVL	IVL Swedish Environmental Research Institute, a non-profit research institute.
KFV	Katastrofhjälp Fåglar och Vilt, the Swedish Wildlife Rehabilitators Association.
Kystverket	Norwegian Coastal Administration, responsible for oil spill preparedness in Norway.
LCD	Lowest Common Denominator, meaning the least interested nations determine the progression pace.
Likert item	A statement that the respondent is asked to evaluate by giving it a quantitative value, often used in surveys.
LOS	Ledning och Samverkan, a MSB management and cooperation project.
MARPOL	International Convention for the Prevention of Pollution from Ships.
MIMIC	Minimizing risks of maritime oil transport by holistic safety strategies, an EU project.
MSB	Myndigheten för Samhällsskydd och Beredskap, the Swedish Civil Contingencies Agency, responsible for civil protection and crisis management through coordination, and training.
MSP	Marine Spatial Planning.
Municipalities	Municipalities are the local representatives of the Swedish Government, responsible for local services, such as physical planning, schools, rescue services, and regulations.
NCP	National Contingency Plan, a national plan for responding to oil and chemical pollution.
NSO	Nationell Samverkansgrupp för Oljeskadeskydd, the National Cooperation Group for Oil Combating, consisting of representatives from SCG, MSB, OSAS, SwAM, SMA, STA, CABs, and SALAR and is tasked with coordinating oil spill preparedness in Sweden.
OILRISK	Applications of ecological knowledge in managing oil spill risk, an EU project.
OPA90	United States Oil Pollution Act of 1990.
OPRC Convention	International Convention on Oil Pollution Preparedness, Response and Co-operation.
OSAS	Oil Spill Advisory Service, a Swedish expert group previously funded by SwAM that gives advice during oil and chemical spills to private and public organisations and authorities.
OSC	On-Scene Commander, a command position in the ICS system.
OSLTF	United States Oil Spill Liability Trust Fund.
OSPAR Convention	Convention for the Protection of the Marine Environment of the North-East Atlantic.
OSPRI	Caspian and Black Sea's Oil Spill Preparedness Regional Initiative.
OSRL	Oil Spill Response Limited, an oil spill response company.
PAHs	Polycyclic Aromatic Hydrocarbons.
PREP	United States National Preparedness For Response Exercise Program.
PSSA	Particularly Sensitive Sea Area, a type of area protection assigned by IMO.
RAC-REMPEITC-Caribe	Regional Activity Center - Regional Marine Pollution Emergency Information and Training Center for the Wider Caribbean.
RETOS™	A readiness evaluation tool for oil spills developed by ARPEL.
RISKGOV	Environmental Risk Governance of the Baltic Sea, an EU project.
SafeSeaNet	EMSA vessel traffic monitoring and information system.

SALAR	Swedish Association of Local Authorities and Regions.
SCG	Swedish Coast Guard, the agency responsible for surveillance, enforcement of regulations, and environmental protection in the Swedish territorial sea and EEZ.
Shell	Royal Dutch Shell, a large international oil and gas company.
SI	Swedish Institute, an agency promoting Sweden through foreign policy, education, international aid, and development.
SMA	Swedish Maritime Administration, the agency responsible for maintaining sea-lanes, and maritime search and rescue.
SMHI	Swedish Meteorological and Hydrological Institute.
SOPEP	Ship Oil Pollution Emergency Plan, required by MARPOL for tankers over 150 gt and other vessels over 400 gt.
SRSA	Swedish Rescue Services Agency, the agency predating MSB.
SSRS	Swedish Sea Rescue Society, a volunteer organisation.
STA	Swedish Transport Agency, regulates and inspects transportation systems.
STD	Standard Deviation.
SwAM	Swedish Agency for Water and Marine Management, the agency responsible for Marine Spatial Planning, sustainable governance, and environmental protection of the sea and waterways.
Sweco	Originally Swedish Consultants, the largest construction, architecture, and environmental engineering consultancy company in Europe.
TOBOS	Teknik for oljebekämpning till sjöss samt bekämpning och sanering av olja i strandzonen, a Swedish project on oil spill response.
TWh	Terawatt hours.
UAE	United Arab Emirates.
UN	United Nations.
UNCLOS	United Nations Convention on the Law of the Sea.
UNEP	United Nations Environment Programme.
USCG	United States Coast Guard.
USEPA	United States Environmental Protection Agency.
VRAKA	Development of a protocol for risk assessment of potentially polluting shipwrecks in Scandinavian waters project.
WMU	World Maritime University, a postgraduate maritime university under the auspices of the IMO.
X^2	Chi-square, a type of statistical test comparing frequency distributions.

Key Definitions

Term	Explanation
Oil spill	Any oil pollution from ships, pipelines, fixed installations, ports etc.
Oil spill management	The organisation of the preparedness, such as the structure, means of communication, and division of responsibility between the organisations.
Oil spill planning	Background knowledge and planning measures, such as risk assessments and contingency planning.
Oil spill preparedness	The ability to respond to oil spills and includes management, and prevention, planning, and response phases.
Oil spill prevention	National or international political mitigating measures, such as international conventions, industry standards, and legislation.
Oil spill response	The capacity to clean up oil through training and exercises on equipment and methods.

Chapter 1 - Introduction

The first chapter describes how oil enters the marine environment, the relevance of the *Fu Shan Hai* accident, and presents the research aims, questions, and dissertation structure.

1.1 Oil in the environment

Oil may enter the marine environment in different ways, for example chronic spills from leaking shipwrecks and operational spills from shipping, but also surface runoff, natural oil seeps, and catastrophic oil spills (Etkin et al., 1998; Farrington & McDowell, 2004; GESAMP, 2007). Approximately 3.2 million tonnes of oil enter the marine environment each year (Etkin et al., 1998), although estimations of this volume range from 0.4 to 4 million tonnes (Etkin et al., 1998; Kvenvolden & Cooper, 2003). A third to half of all oil entering the marine environment originates from natural seeps in the ocean, originating from oil-laden sediments pushed to the surface by natural geological processes (see Figure 1) (Farrington & McDowell, 2004). Such seeps are usually very old and a specialised ecosystem has evolved around them, with organisms capable of living in an environment with a high concentration of oil in the surrounding water.

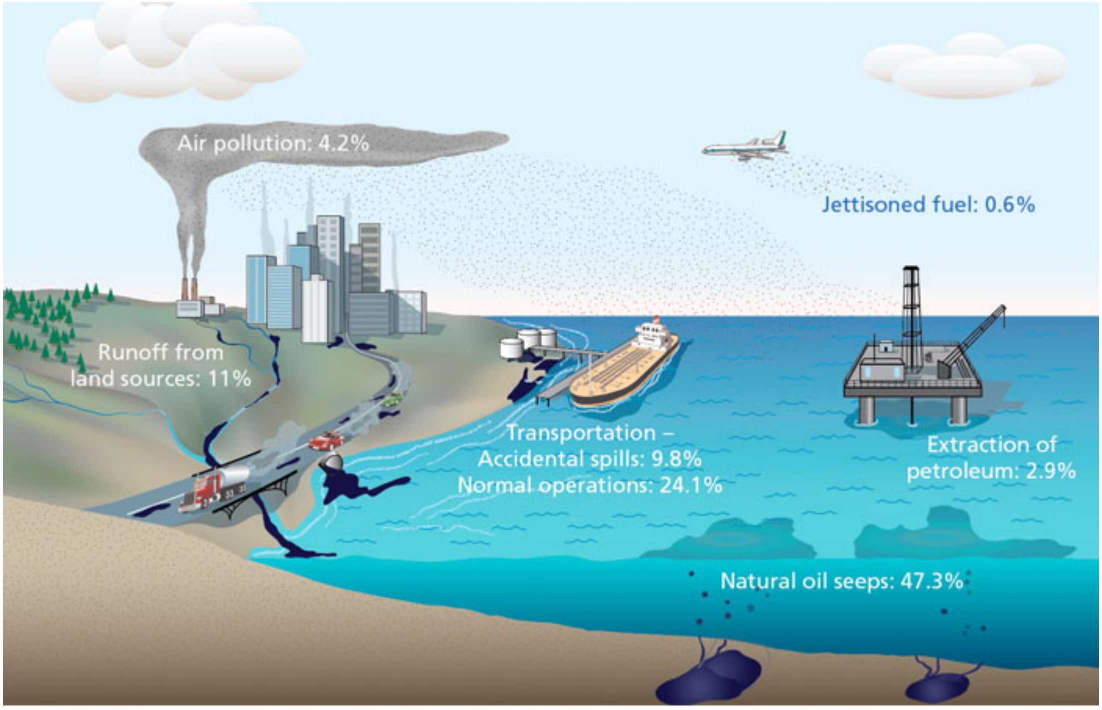

Figure 1: Global input of oil to the marine environment from different sources (Farrington & McDowell, 2004).

Smaller, continuous discharges of oil, for example from leaking wrecks, ships, and infrastructure, have sub-lethal effects at the ecosystem level (F. J. Lindgren, Hassellöv, & Dahllöf, 2012a; 2012b). However, oil spill impacts depend on the type of oil and where the oil pollution occurred (Kingston, 2002; NRC, 2003). Even larger organisms may suffer from continuous spills, for example thousands of seabirds are killed every year by smaller chronic spills in the Baltic Sea, attributed to originate from the shipping traffic (K. Larsson & Tydén, 2005; 2011).

The focus of this dissertation is on accidental spills, which account for 10% of the oil entering the ocean (see Figure 1) (Farrington & McDowell, 2004). An oil spill is a form of pollution and is defined in this dissertation as the release of liquid petroleum hydrocarbons into the environment from human activities. Due to the catastrophic nature of the larger of these spills, the environmental (Crawford et al., 2000; Elmgren, Hansson, Larsson, Sundelin, & Boehm, 1983; Morales-Caselles et al., 2008; NRC, 2003) and socioeconomic impacts (Forsman, 2007a; Rodriguez-Trigo et al., 2010) could be severe. However, these impacts are not directly related to the size of the spill. A smaller spill at an unfortunate time and place could also result in severe consequences. For example, the *Exxon Valdez* accident in Alaska in the United States 1989, spilled 35,000 tonnes of oil and 35,000 seabirds died as a result. This stands in contrast to the *Braer* accident off the Shetland Islands in the United Kingdom 1993, when 85,000 tonnes of oil were spilled and “only” 1,500 seabirds died (Kingston, 2002). However, most oil spills are much smaller in volume (ITOPF, 2015).

1.2 *Fu Shan Hai*

At approximately 12:18 on Saturday 31 March 2003, the Cyprus-registered 5,200 deadweight tonnes (dwt) container vessel *Gdynia* collided with China registered 70,000 dwt bulk carrier *Fu Shan Hai*. This happened approximately 3 nautical miles north northwest of Hammer Odde on Bornholm, a Danish island off of the southern coast of Sweden (DMA, 2003). The weather was clear, but due to bad judgement and a lack of communication, *Gdynia* hit *Fu Shan Hai* amidships on her port side. *Gdynia* suffered only light damage to her prow and could later return to a shipyard in the Polish city Gdynia, while *Fu Shan Hai* immediately took in water. Swedish, Danish, and German authorities were alerted and responded by immediately sending response vessels to the area. The crew of *Fu Shan Hai* abandoned the sinking vessel at 13:50, after taking measures to minimise oil leakage. As the hours passed, the bow of *Fu Shan Hai* sank more and more and after an aborted towing attempt, the ship sank at 20:49 and came to rest at 65 m depth (DMA, 2003; Kustbevakningen, 2013b).

On Sunday 1 June, the Swedish Coast Guard reported that the wreck had leaked approximately 40 m^3 of oil and that this oil was moving towards the Swedish coast (Kustbevakningen, 2013b). *Fu Shan Hai* had a cargo of 66,000 tonnes of pot ash, potassium chloride fertilizer, and carried 1,672 tonnes of fuel oil, 110 tonnes of diesel, and 35 tonnes of lubricating oils (DMA, 2003; Ljungkvist, 2003). At 19:00, the local Swedish rescue service, Southeast Skåne’s Fire and Rescue Service, was alerted and was sent an oil spill drift projection from the Coast Guard. This was the first such oil spill response for the rescue service. An oil spill contingency plan did not exist and the organisation had no knowledge about oil spills at sea. There was even some confusion as to whether the rescue service was responsible at all. The response procedure followed the normal emergency response routines and the relevant organisations were alerted. Additionally, the closest of the Swedish Oil Spill Depots, which are the regional oil spill response equipment stockpiles, was called in (Ljungkvist, 2003).

On Monday 2 June, the rescue service staff met and were briefed by the Coast Guard that oil was projected to reach the shoreline within 24 hours (Kustbevakningen, 2013b; Ljungkvist, 2003). This was the starting point of the Emergency Response phase for the rescue service, which is legally defined as the initial response phase of any rescue operation (Sveriges Riksdag, 2003). An oil spill response strategy was formed, response plans were drawn, communications were set up, and response priorities were made.

During the following three weeks, there was intense activity around the oil spill. The originally planned 50 responders peaked at 500 persons, in addition to the staff that was handling management, documentation, logistics, and other roles. Simultaneously at sea, six Swedish Coast Guard vessels, four Danish, and two German response vessels were collecting oil (Kustbevakningen, 2013b). The Swedish Armed Forces, with its conscripts and volunteer organisations, turned out to be of great help during the response.

On Saturday 7 June, the Emergency Response phase ended and the clean-up phase began. This meant that the responsibility (and therefore, cost) was shifted directly from the rescue service to the affected municipality, Ystad. In practice, much of the work and response organisation remained the same as before, with the military conscripts and rescue service personnel cleaning up the beach. By then, the event had triggered massive media interest in Sweden and several ministers, including the Swedish Prime Minister at the time, visited the clean-up sites (Ljungkvist, 2003).

The oil came ashore in several waves from the still leaking wreck along 60 km of the shore, and 36.3 km of oiled beach was cleaned in total. A total of 3,900 tonnes of oily sand was collected on land and 375 m^3 of oil and water emulsion were collected by the rescue service (Ljungkvist, 2003). A further approximately 1,000 tonnes of oil emulsion was collected by the Coast Guard (Kustbevakningen, 2013b). The impacted beaches had no trace of oil when revisited four years later (Martinsson & Fejes, 2007). The cost of the response operation for the Swedish Coast Guard amounted to 10 million SEK (~1.3 million USD) and the cost for the municipalities amounted to 15 million SEK (~2 million USD). The total cost, including clean-up and the cost of the loss of the cargo and vessel amounted to over 1 billion SEK (~130 million USD).

The evaluations of the oil spill response reported that despite not having an oil spill contingency plan, the ad-hoc nature of the response worked well concerning management, response, cooperation, and volunteers (Fejes, Lindgren, & Mahlander, 2004; Ljungkvist, 2003). What did not work as well were the oil spill drift projections, communication between the different parties involved, and the division of responsibilities. It was pointed out that the response was very lucky with the seasonal timing of the event when it came to environmental effects. An easily cleaned sandy beach dominated the impacted shore and the weather was clear with mild winds for most of the period. Moreover, plenty of staff was accessible in the form of the local Swedish Armed Forces and the rescue service had more than 24 hours to prepare for the arrival of the oil. All of these factors added to the claimed success of the response, but these extremely fair conditions cannot and should not be counted on for future spills.

The oil spill response to the *Fu Shan Hai* accident was unprecedented in Sweden at the time and laid the foundation for the Swedish national work on oil spill preparedness during the late 2000s and early 2010s, especially for contingency planning. In this way, it laid the foundation for the work on Swedish oil spill preparedness that is analysed in this dissertation.

1.3 Aim

The aim of this dissertation is to better understand the state of oil spill preparedness in Sweden today and use the findings to recommend improvements. Oil spills refer to any oil pollution from ships, pipelines, fixed installations, ports etc. Oil spill preparedness refers to the ability to respond to oil spills and includes overall management, prevention, planning, and response. This is done by analysing Swedish preparedness as a case study and explaining the causes of any deficiencies in national preparedness. Any oil spills affecting the Swedish territorial sea or Exclusive Economic Zone (EEZ) are considered. The study seeks to answer the overall research question:

Is Sweden prepared to handle a large oil spill?

This question is divided into five sub-questions about Swedish oil spill preparedness:

1. Is the oil spill preparedness regime effectively managed?
2. Is the political commitment for oil spill prevention sufficient?
3. Are the existing contingency planning measures sufficient?
4. Are the existing response measures sufficient?
5. Is the oil spill preparedness regime equivalent to international practice?

1.4 Dissertation structure

The dissertation is divided into ten chapters. Chapters 1 to 4 describe the background of the dissertation and explain the methodology used. Chapters 5 to 9 present and discuss the results of the study. Chapter 10 concludes the dissertation with reflections and recommendations.

Chapter 1 - Introduction

The first chapter describes how oil is entering the marine environment, the *Fu Shan Hai* accident and its significance, and presents the research aims, questions, and the dissertation structure.

Chapter 2 - Background

The second chapter analyses current trends in oil trade and transport, and current trends in oil spills globally and around Sweden specifically. It also describes the behaviour and impacts of oil spills.

Chapter 3 - Literature Review

The third chapter gives a critical review of oil spill preparedness by examining management, prevention, planning, and response discourse in Sweden and internationally.

Chapter 4 - Methodology

The fourth chapter explains the research context, scope, and rationale. It justifies the hypotheses, approach, and methods used. The Oil Spill Preparedness model used in this dissertation is explained and compared to other frameworks. The data collection is elaborated, the analyses explained, and quality control and research ethics are discussed.

Chapter 5 - Management

The first of the five results chapters focuses on the management part of oil spill preparedness and specifically the Swedish management structure. The oil spill preparedness network in Sweden is mapped and compared to the formal roles of the organisations and the opinions of the survey respondents.

Chapter 6 - Prevention

The second of the five results chapters focuses on the prevention part of oil spill preparedness and specifically the Swedish political commitment to and implementation of, international legislation related to oil spills. International cooperation agreements and the Swedish role in them are also analysed.

Chapter 7 - Planning

The third of the five results chapters focuses on the planning part of oil spill preparedness and specifically the Swedish system for oil spill contingency planning. Planning measures for the governmental agencies, County Administrative Boards, and the status of oil spill contingency planning in Sweden are analysed.

Chapter 8 - Response

The fourth of the five results chapters focuses on the oil spill preparedness part of response and specifically the Swedish training and exercise system. Training measures, exercises and equipment for Swedish governmental agencies, County Administrative Boards and municipalities are examined.

Chapter 9 - International Practice

The fifth and final of the results chapters compares international and Swedish oil spill preparedness practices. Selected measures are quantified and a standardised evaluation tool is used to compare Sweden to neighbouring countries.

Chapter 10 - Conclusion

The final chapter summarises findings of the dissertation and explains the implications of the causal relationships. Recommendations, limitations, and future research topics are also presented.

1.5 Conclusion

This introductory chapter presents the extent of oil pollution from accidents and highlights the importance of the 2003 *Fu Shan Hai* accident for Sweden. The experiences of the management and the response to the spill came to influence and invigorate the development of oil spill preparedness in Sweden afterwards. Thanks to fortunate circumstances, such as the availability of military personnel, a full day of preparation for the local rescue service, agreeable weather, oil impacting on a less sensitive shoreline type, and scarce wildlife at that time of the year, the response was considered a success. However, these circumstances cannot and should not be counted on for future oil spills.

What is the state of oil spill preparedness in Sweden in 2015, twelve years after the *Fu Shan Hai* accident? There is a need to thoroughly examine the status of oil spill preparedness in Sweden, and if necessary, improve it.

Chapter 2 - Background

The second chapter analyses current trends in oil trade and transport, and current trends in oil spills globally and around Sweden specifically. Environmental and economic impacts of oil spills are also discussed in a global and Swedish context.

2.1 Oil trade and transport

Despite current initiatives to move to sustainable sources of energy and renewable fuels, global demand for crude oil and oil products is still increasing. Demand rose from 2.7 million tonnes per day (t/d) in 1960 to 12.3 million t/d in 2013 (OPEC, 2014a). The industry anticipates an increase in demand from 12.3 million t/d to 13.1 million t/d in 2019, related to the expected consumption increase in Asia (OPEC, 2014b).

Tanker vessels transport most of the oil from production regions all over the world to consumption markets in Asia, Europe, and North America. There are approximately 47,500 ships of more than 1,000 gross tonnage (gt) in the world shipping fleet (UNCTAD, 2014), excluding fishing and naval vessels. Approximately 4,900 of these are oil tankers, with a combined capacity of 470 million deadweight tonnes (dwt) (OPEC, 2014a). Together, these tankers transported 1.8 billion tonnes of crude oil in 2013 (UNCTAD, 2014). Industry reports shows a gradual shift in the consumer market, with a decreasing export of oil and gas from the Middle East to Europe and North America and an increasing export to Asia (OPEC, 2014b). Increased transport logically corresponds to an increased risk of oil spill accidents, but enhanced ship safety measures and crew training has developed in parallel and the number of oil spills greater than seven tonnes has declined since 1975 (see Figure 2) (ITOPF, 2015).

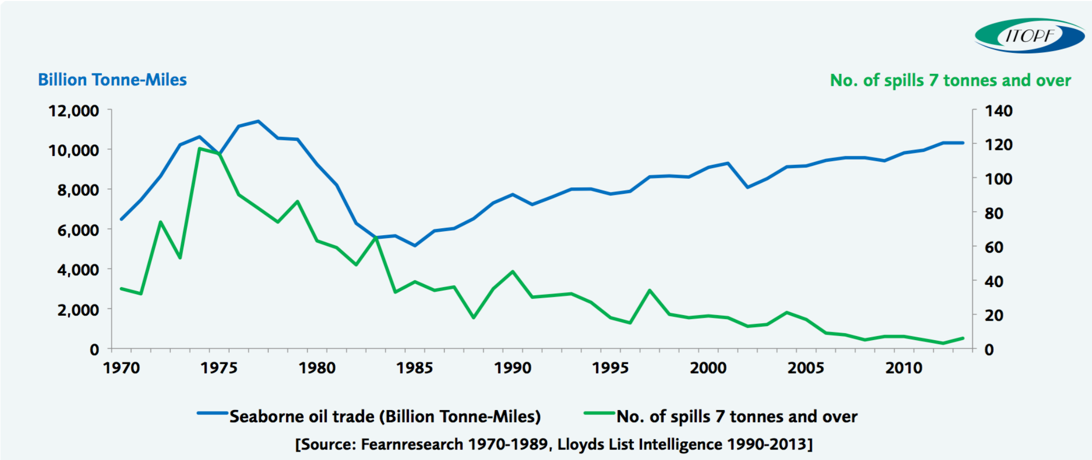

Figure 2: Seaborne trade of crude oil and product vessels of 60,000 dwt and over from 1970 to 2013 and number of recorded oil spills greater than seven tonnes during the same period (ITOPF, 2015). Figure used with permission.

However, it is not just tankers that pose a risk for oil spills. All types of ships carry various types of bunker fuel oil, diesels and lubricants for their engines and generators. The largest container vessels have more fuel in their tanks than small tankers carry as cargo. Even ships that follow all international safety standards and have the latest technology and safety measures installed, run the risk of causing oil spill accidents. Additionally, oil rigs and terminals report accidents resulting in oil spills, estimated to be 3% of the total oil input to the marine environment (Farrington & McDowell, 2004). Most of these are smaller leaks, but large blowouts occasionally occur, for example *Deepwater Horizon* in the Gulf of Mexico in 2010.

2.1.1 Oil trade and transport around Sweden

The Baltic Sea is one of the busiest shipping areas in the world, with approximately 2,000 vessels in the area at any given moment (HELCOM, 2011b). Around 15% of global shipping trade is transported on the Baltic Sea, including 11% of the global oil transport. In 2012, there were a total of 407,425 crossings of Automatic Identification System (AIS) lines reported in the Baltic Sea (HELCOM, 2014a). This is an increase of 8.2% from 376,671 crossings in 2006, although Baltic Sea crossings have been fairly stable between 2006 and 2012 (see Figure 3) (HELCOM, 2014a).

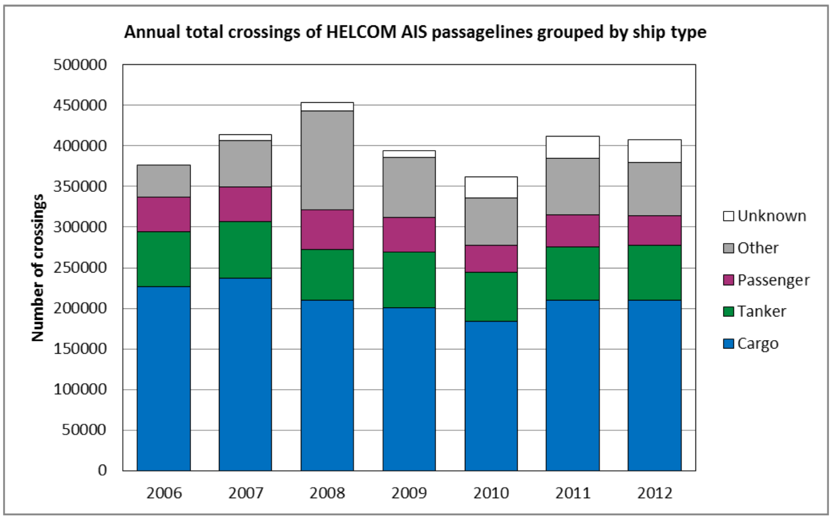

Figure 3: Annual total crossings of HELCOM AIS lines in the Baltic Sea by ship type (HELCOM, 2014a).

AIS lines are defined geographic lines and the number of crossings from one side of the line to the other is recorded. This is done by the AIS transponder that all ships above 300 gt are required to have by the International Maritime Organization (IMO, 1974).

These data include AIS lines from the inner Baltic Sea up to the Skaw on the west coast of Sweden. This includes the large Swedish west coast ports of Gothenburg and Brofjorden, and gives an accurate estimation of the shipping activity in all waters around Sweden, not exclusively the Baltic Sea. What is missing from these data are vessel movements in Swedish inland waters.

The volume of oil transported in the Baltic Sea has also increased during the 2000s, as data from the 16 largest Baltic Sea ports show (see Figure 4) (MSB, 2013b).

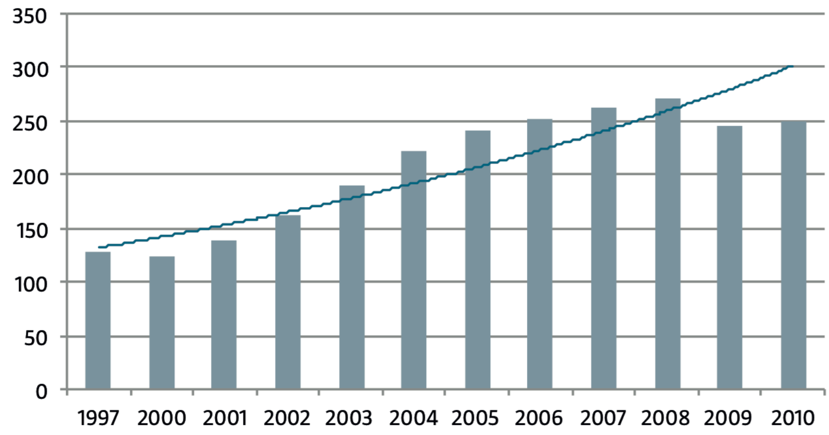

Figure 4: Oil transportation from the 16 largest ports in the Baltic Sea in million tonnes (MSB, 2013b).

The increase is largely due to the expansion of Russian oil ports in the Gulf of Finland: Primorsk, Vysotsk, and Ust-Luga (Brunila & Storgård, 2012; Yurchenko, 2014). The 2001 completion of the Baltic Pipeline System expansion to the existing Druzhba system connected the Russian oil fields in the West Siberia and Urals-Volga regions to the Baltic Sea through the Primorsk oil terminal outside of Saint Petersburg (see Figure 5) (Brunila & Storgård, 2012; EIA, 2015; Franklin, 2010; Petersen et al., 2011). The 2012 completion of the Baltic Pipeline System II rerouted all oil previously destined for Europe to the new port of Ust-Luga in the Baltic Sea, following Russian disagreements with Belarus over payments.

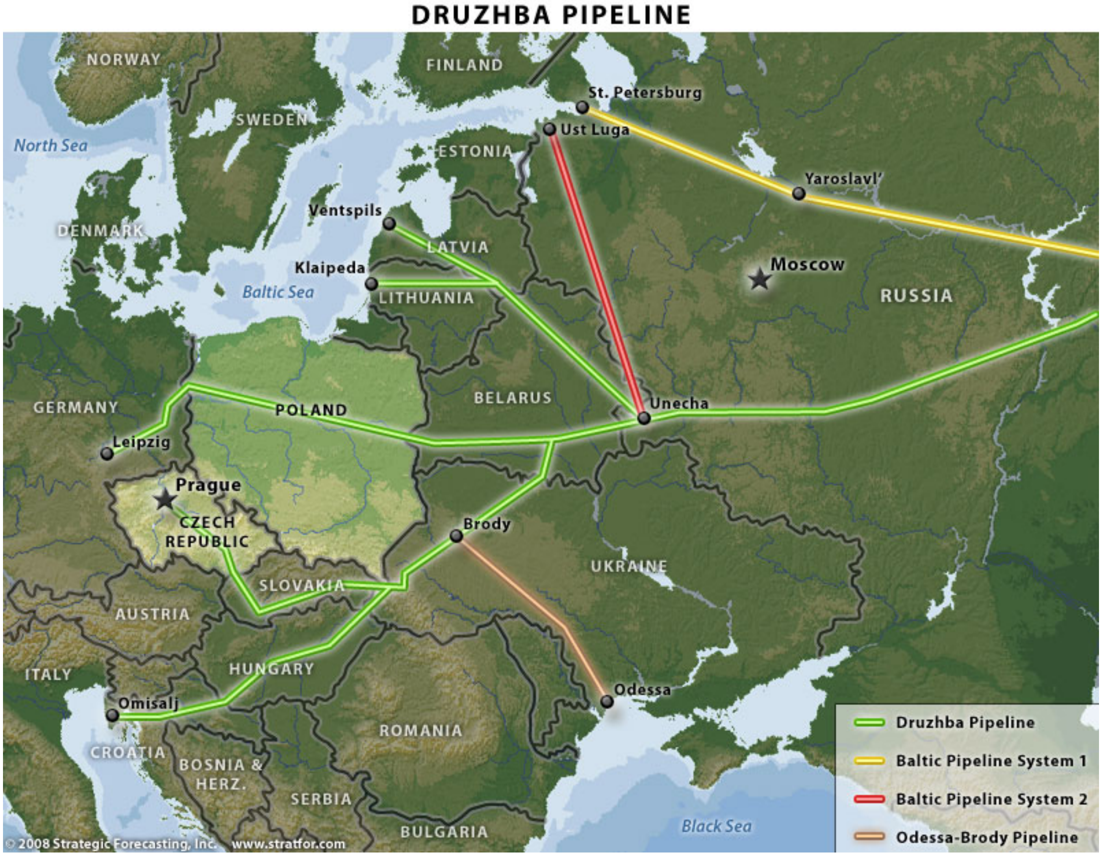

Figure 5: The Druzhba pipeline system and the connections to the Baltic Pipeline System 1 and 2 (Franklin, 2010).

In total, oil turnover from these Russian Baltic Sea ports increased from 10 million tonnes in 2001 to 129 million tonnes in 2014 (see Figure 6) (PASP, 2015).

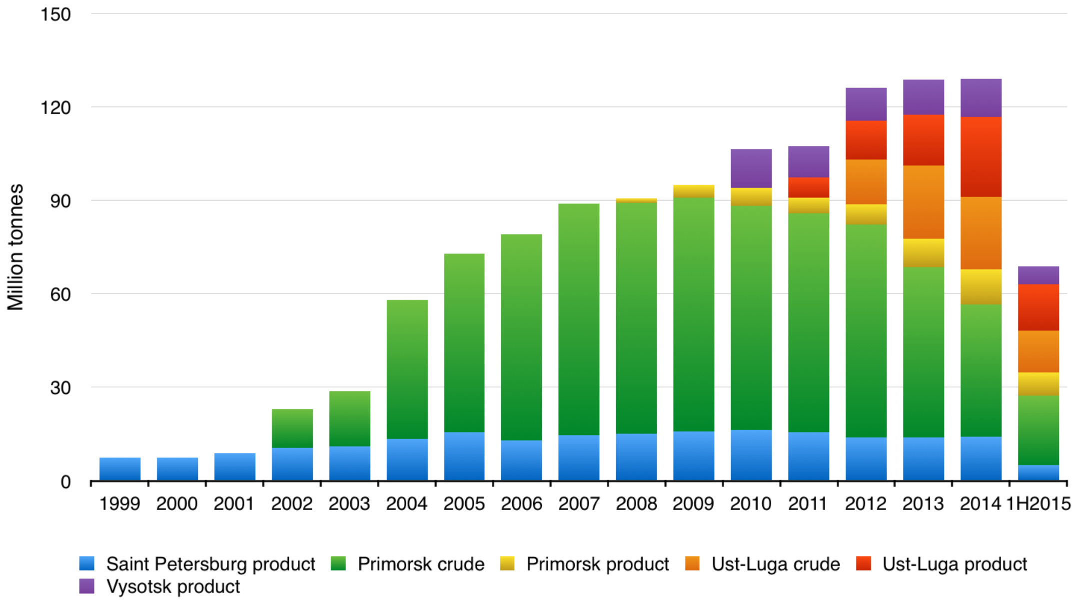

Figure 6: Turnover of million tonnes of oil exported from the largest Russian ports in the Gulf of Finland (PASP, 2015).

Future plans are to increase the Russian crude oil exports from the current 224 million tonnes in 2014 to 280 million tonnes by 2035 with a 3 million tonnes increase in 2015, according to Russia's Energy Minister (Soldatkin, Golubkova, Korsunskaya, Lyrchikova, & Astakhova, 2015). This includes export from the large ports in Novorossiysk in the Black Sea (exporting 66 million tonnes in 2014) and Kozmino outside Vladivostok in the Pacific Ocean (exporting 24 million tonnes in 2014), and will take place in spite of low market prices for crude oil (EIA, 2015). Russia has been diverting crude oil to its refineries in the wake of sanctions over the conflict in Ukraine and falling crude oil prices, but aims to increase exports again following a modernisation programme of its refineries (Soldatkin et al., 2015). Oil export from Russia to China is also increasing, with plans to export 31 million tonnes in 2015, compared to 3 million tonnes in 2014.

Tanker traffic is expected to keep increasing in the Baltic Sea and larger ships are expected to replace smaller vessels, as these are more cost-effective (Brunila & Storgård, 2012; Rådberg & Gyllenhammar, 2012). However, the 17 m draught restriction in the Danish Store Bælt strait, the 7.7 m restriction in the Sound between

Denmark and Sweden, and the relatively shallow ports in the Baltic Sea limit ship size (Antoniewicz et al., 2007; NGA, 2014) to the B-Max or Baltimax class with an upper limit of 200,000 dwt (Stena Bulk, 2012). Larger oil tankers cannot enter the Baltic Sea and are often found off northeastern Denmark, lightering from smaller feeder tankers that can enter the Baltic Sea.

2.2 Oil spills

The first oil tanker accident that led to a large oil spill was *Torrey Canyon*, which ran aground on the Seven Stones reef off of the southwestern tip of the United Kingdom on 18 March 1967. *Torrey Canyon* released its full cargo of 119,000 tonnes of crude oil during the following 12 days, polluting large parts of the coast of the southern United Kingdom and northwestern France (ITOPF, 2014b; Smith, 1968). The incident led to the development of important international conventions, in the 1969 International Convention on Civil Liability for Oil Pollution Damage (CLC Convention), the 1971 International Convention on the Establishment of an International Fund for Compensation for Oil Pollution Damage (FUND Convention), and the 1973 International Convention for the Prevention of Pollution from Ships (MARPOL) (IMO, 1978; IOPC Funds, 2011), discussed in Chapter 6.

Since then, the International Tanker Owners Pollution Federation (ITOPF) have collected information on over 1,800 oil spills of more than seven tonnes (ITOPF, 2014a). However, there are far more spills that remain unreported or are below seven tonnes, as indicated for example by aerial surveillance in the Baltic Sea (HELCOM, 2014c). The distribution of the number of oil spills and average number of spills per decade indicates a clear decreasing trend since the 1970s (see Figure 7).

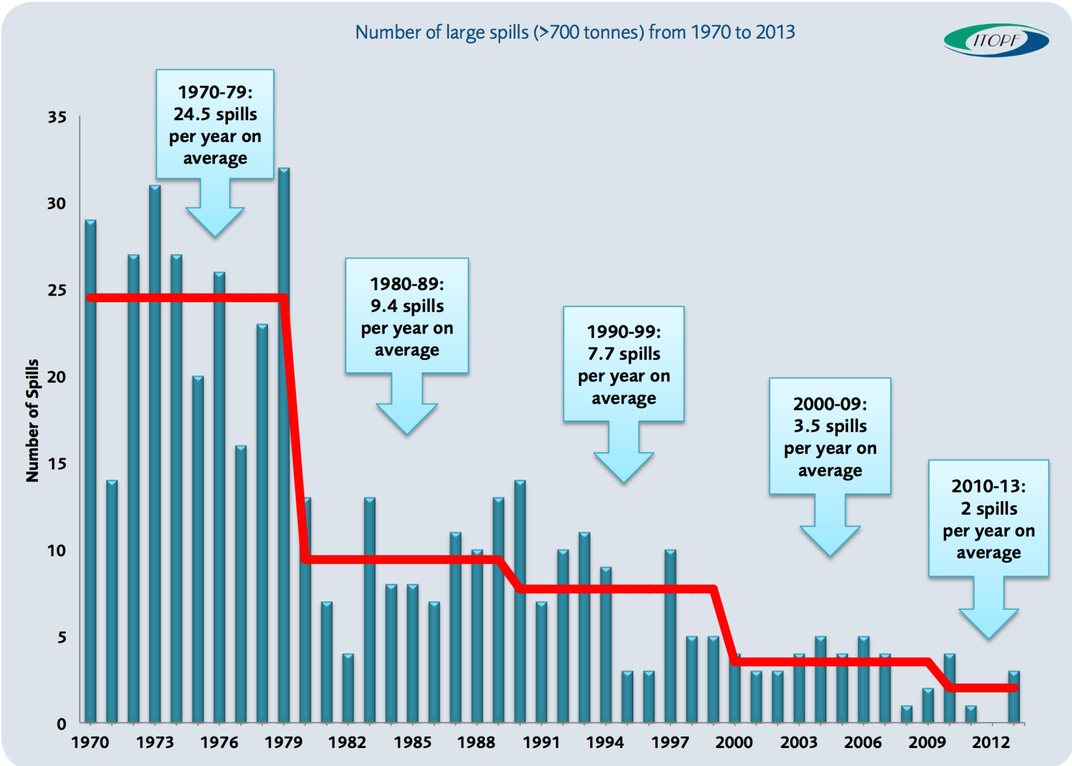

Figure 7: Number of oil spills between 1970 and 2013 and average number of spills per decade (ITOPF, 2014a). Figure used with permission.

Indeed, in 2014 only five spills of seven tonnes or over were recorded (MarEx, 2015). The decreasing number of spills between 1970 and 2013 (see Figure 7) have naturally led to a decrease in volume of oil spilled (see Figure 8) (ITOPF, 2014a).

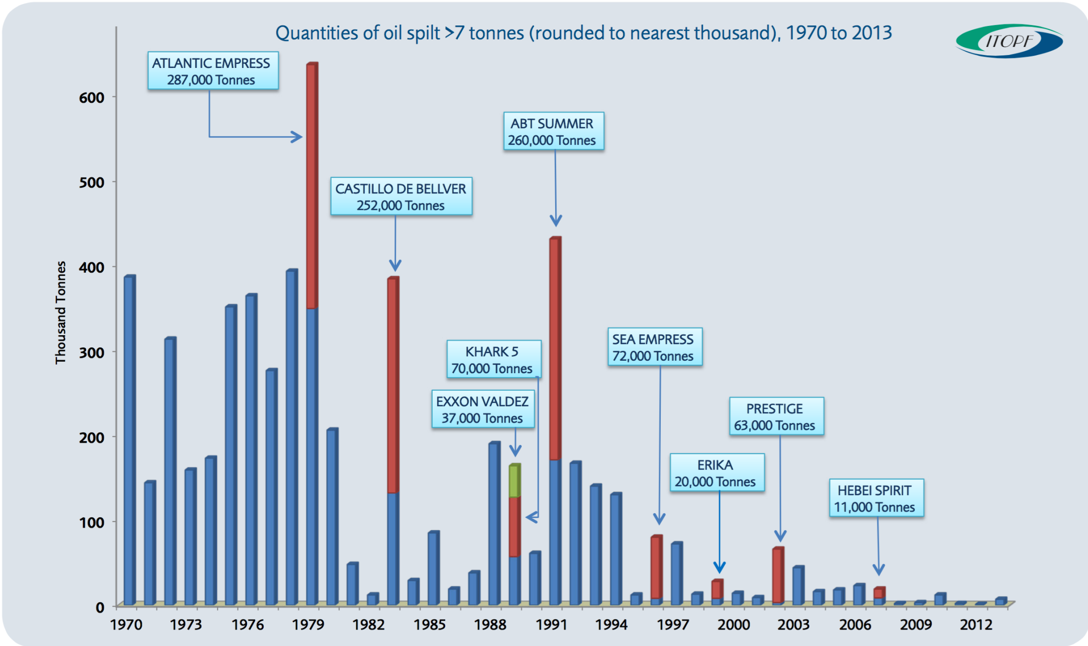

Figure 8: Recorded volume of oil spilled of more than seven tonnes per accident between 1970 and 2013, with selected larger oil spills marked (ITOPF, 2014a). Figure used with permission.

The impact of a selected few dominant and named oil spills is evident in the annual quantity for the respective years.

2.2.1 Oil spills around Sweden

No large oil spills have occurred around Sweden on the same scale as highly publicised international accidents, such as *Prestige* in Spain in 2002 or *Exxon Valdez* in the United States in 1989 (see Table 1) (Anders Jahres Rederi, 2012; "Environmental Implications of Oil Spills from Shipping Accidents," 2010; GESAMP, 2007; HELCOM, 1998; 2001; Rambøll Barents, 2010; Rylander, 2005; SST, 1983; 1985; Sveriges Riksdag, 1973; Veiga & Wonham, 2002).

Table 1: Largest oil spills around Sweden (Anders Jahres Rederi, 2012; "Environmental Implications of Oil Spills from Shipping Accidents," 2010; GESAMP, 2007; HELCOM, 1998; 2001; Rambøll Barents, 2010; Rylander, 2005; SST, 1983; 1985; Sveriges Riksdag, 1973; Veiga & Wonham, 2002).

Name	Year	Location	Spill size (tonnes)
Globe Asimi	1981	Klaipėda, Soviet Union (Lithuania)	16,000
Antonio Gramsci	1979	Ventspils, Soviet Union (Latvia)	5,500
Ludwig Svoboda	1985	Ventspils, Soviet Union (Latvia)	5,000
North Pacific	2001	Klaipėda, Lithuania	3,427
Baltic Carrier	2001	Kadetrenden, Denmark	2,700
Fu Shan Hai	2003	Ystad, Sweden	1,200
Jawachta	1973	Trelleborg, Sweden	1,000
Volgoneft 263	1990	Karlskrona, Sweden	1,000
Tsesis	1977	Stockholm, Sweden	1,000
José Martin	1981	Dalarö, Sweden	1,000
Irini	1970	Nynäshamn, Sweden	1,000
Golden Star	1976	Baltic Sea, Sweden	996
Sivona	1982	The Sound, Sweden/Denmark	800
Full City	2009	Langesund, Norway	700
Antonio Gramsci	1987	Vaarlshti, Finland	650
Esso Nordica	1970	Pellinki, Finland	600
Golden Trader	2011	Impact on Tjörn, Sweden	500
Pensa	1970	Hailuoto, Finland	500
San Nikitas	1983	East of Söderhamn, Sweden	500
Irenes Sincerity	1976	Baltic Sea, Sweden	500
Sefir	1981	Öland, Sweden	498

Many of these ships were not tankers spilling cargo oil, but rather ships spilling bunker fuel. The two most recent accidents were *Golden Trader*, which spilled oil off the north coast of Denmark in September 2011 and impacted the Swedish west coast island Tjörn several days later, and a pine-oil spill from a product tank on land in the port of Söderhamn in December 2011. The largest oil spill on record in the Baltic Sea is *Globe Asimi* outside Klaipėda in Lithuania 1981 (then part of the Soviet Union), which spilled approximately 16,000 tonnes of oil. In Swedish waters, the largest confirmed spill is *Fu Shan Hai,* described in the introduction, off the Swedish south coast in 2003, which spilled 1,200 tonnes of oil.

In addition to these larger oil spill accidents, there are many smaller accidental or deliberate discharges which may not be reported. These small, chronic oil spills have a different impact compared to the larger catastrophic oil spills (K. Larsson & Tydén, 2011; F. J. Lindgren, 2012), which will be elaborated on later in this chapter. Small operational discharges of up to 15 ppm concentration, for example from propeller lubricants and bilge water, are allowed from ships under the MARPOL Convention, with some restrictions depending on the location of the ship (IMO, 1978). Oil spills in the Baltic Sea observed via aerial surveillance have declined by 77% between 1988 and 2014 (HELCOM, 2015). The decline in reported spills is evident despite increased surveillance time, meaning that the number of spills observed per flight hour has decreased substantially (see Figure 9).

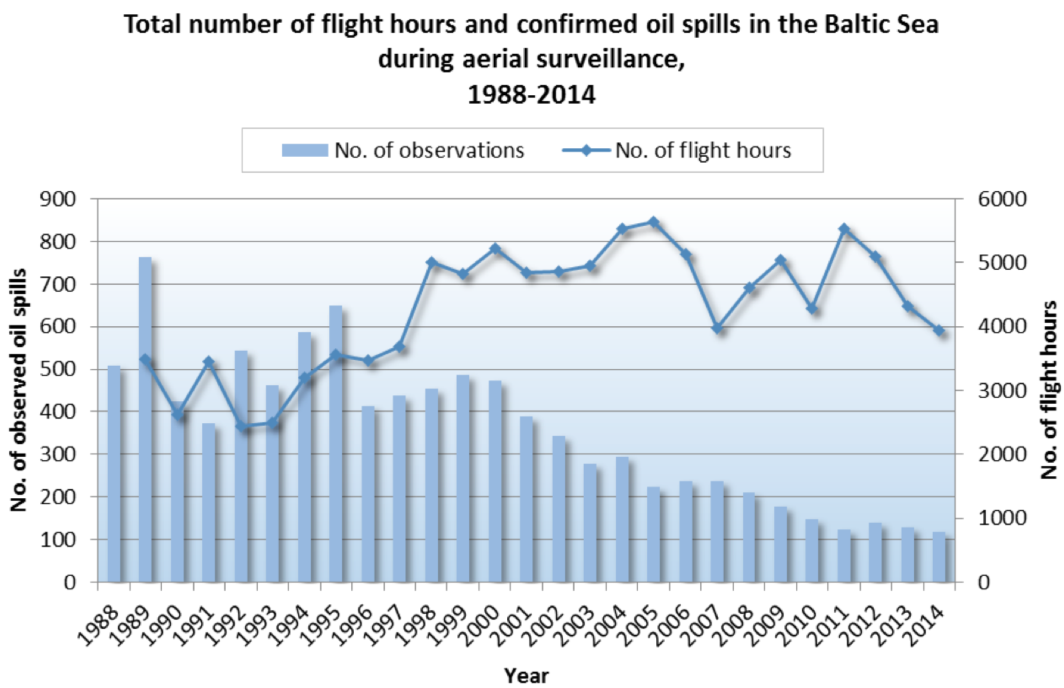

Figure 9: Number of confirmed oil spills and number of aerial surveillance flight hours between 1988 and 2014 in the Baltic Sea (HELCOM, 2015).

There were between 105 and 149 shipping accidents annually between 2004 and 2012, with 4 to 13 of these leading to pollution (see Figure 10) (HELCOM, 2014a).

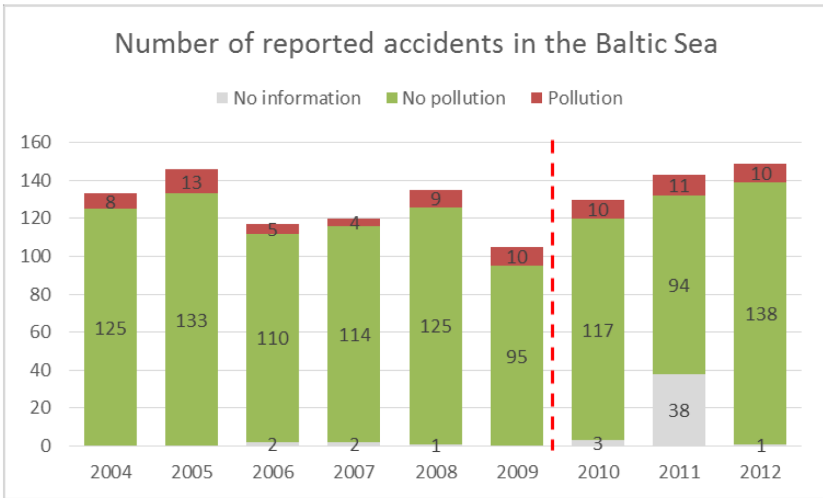

Figure 10: Number of shipping accidents in the Baltic Sea between 2004 and 2012 (HELCOM, 2014a).

This trend is fairly stable, with an average of 131 accidents per year, despite increasing traffic (HELCOM, 2012). This likely reflects the improved safety measures taken in the Baltic Sea, as well as better training of the crew, and improved equipment on board (COWI, 2012c).

2.3 Oil spill impacts

Even a single oil spill can have significant consequences, both for the environment and the economy in the affected area. Well known accidents such as *Exxon Valdez* in Alaska in the United States 1989, *Erika* off Bretagne in France 1999, and *Prestige* off Galicia in Spain 2002, have all led to much research on the effects of oil spills, examining different aspects of environmental and socioeconomic impacts.

2.3.1 Oil

Oil consist primarily of hydrogen and carbon molecules collectively called hydrocarbons (NRC, 2003). Hydrocarbons can be further subdivided into non-petroleum based oils, such as animal fats and vegetable oil, and petroleum based oils, such as crude and refined oil. Petroleum hydrocarbons are thus naturally occurring hydrocarbon substances and can occur in gas, liquid, or solid form, depending on the length of the carbon chain (Kingston, 2002). Hydrocarbons are formed by the decay of organic substances trapped within sedimentary rocks. High temperature and pressure convert the trapped matter into hydrocarbons over millions of years.

2.3.1.1 Crude oil

Liquid hydrocarbons found in nature are referred to as crude oil. Crude oil is the raw version of oil and the substance that is extracted from oil wells. This oil is the most complex one, containing hundreds of different hydrocarbon molecules and other organic and inorganic substances, such as sulphur, nitrogen, and oxygen, as well as metals such as iron, vanadium, nickel, and chromium. Crude oil is considered to be *sweet* if it has a sulphur content less than 1% weight and *sour* if it is more than 1% weight. Crude oil contains lighter hydrocarbon fractions that are refined into kerosene (airplane fuel), petroleum (gasoline) and diesel (fuel for cars and trucks), medium fractions that are refined into different grades of Intermediate Fuel Oils (IFOs, ship bunker fuel), and heavy fractions such as asphalt (used in road construction). Oil density is measured as American Petroleum Institute (API) specific gravity at 20° C. It is considered to be *heavy* if it consists of longer hydrocarbon chains and has an API gravity of 22° or less, *medium* if the API gravity is between 22 and 38°, and *light* if it consists of shorter chains and has an API gravity above 38° (UBS, 2004). The composition of crude oil varies with its geographical source (Wang et al., 2003), and this is why the industry often refers to different crude oils by their place of origin. For example, some market benchmarks are West Texas Intermediate Crude, Brent Crude, and United Arab Emirates (UAE) Dubai crude. There are also blended crudes, which mixes oil from different places of origin, for example Russia's main export Urals Blend, consisting of heavy sour crudes from the Urals-Volga region and light sweet crudes from West Siberia (EIA, 2015).

Crude oil can be categorised into saturates (alkanes and cycloparaffins), aromatics (mono- and polycyclic), resins (aggregates of pyridines, quinolones, carbazoles, thiophenes, sulfoxides, and amides), and asphaltenes (aggregates of polyaromatics, naphtenic acids, sulphides, polyhydric phenols, fatty acids, and metalporphyrins)

(Sugiura, Ishihara, Shimauchi, & Harayama, 1996). Alkanes and cycloalkanes normally constitute about 80% of the oil and have similar properties. The remaining hydrocarbons are mostly aromatic, meaning the molecules are unsaturated and made up of benzene rings. Polycyclic Aromatic Hydrocarbons (PAHs) belong to this group. One additional group of hydrocarbons that occurs in varying amounts up to 10% in crude oil is the asphaltenes, which are the heaviest crude oil molecules. Oil with a high proportion of asphaltenes tends to be thick and similar to asphalt.

2.3.1.2 Polycyclic Aromatic Hydrocarbons (PAHs)

Polycyclic Aromatic Hydrocarbons (PAHs), also known as Polyaromatic Hydrocarbons or Polynuclear Aromatic Hydrocarbons, can be found in nature as a component of crude oil. PAHs are created when coal or carbohydrates are heated without sufficient oxygen to cause complete combustion (Wang et al., 1999). This can happen in industrial processes or in car engines. The simplest form is called benzene and consists of six carbon atoms in a ring with attached hydrogen atoms. PAHs are generally fat-soluble and in some cases bioaccumulating (Gehle, 2009; Jenssen, 1996). Under certain conditions, PAHs adhere to sedimenting particles in aquatic environments, where they can persist for a long time with little degradation (Jewett, Dean, Woodin, Hoberg, & Stegeman, 2002; Peterson et al., 2003; Wang, Fingas, Owens, Sigouin, & Brown, 2001). Some PAHs are slightly toxic or non-toxic, while others are strong carcinogens and mutagens in animals and humans (for example benzene) (Bowyer et al., 2003; Gehle, 2009; Jenssen, 1996; Lerda, 2010; Nielsen, Jørgensen, Larsen, & Poulsen, 1996; Peterson et al., 2003). The toxicity of PAHs depends on the composition of the different molecules in the compound. The standard method for reporting PAHs is the individual concentration of 16 common and well studied PAHs (Naphthalene, Acenaphthene, Acenaphthylene, Anthracene, Phenanthrene, Fluorene, Fluoranthene, Benzo(a)anthracene, Chrysene, Pyrene, Benzo(a)pyrene, Benzo(b)fluoranthene, Benzo(k)fluoranthene, Dibenz(a,h)anthracene, Benzo(g,h,i)perylene, and Indeno[1,2,3-cd]pyrene), and the total concentration of these is often called the 16 USEPA PAHs, after the United States Environmental Protection Agency (Bojes & Pope, 2007; NRC, 2003).

2.3.2 Oil behaviour

Once oil gets into the water, several different processes start to affect the behaviour of the oil (see Figure 11). These processes are collectively called weathering and their relative importance varies with time and the characteristics of the oil ("Environmental Implications of Oil Spills from Shipping Accidents," 2010; ITOPF, 2011e; Kingston, 2002; Singsaas & Lewis, 2011).

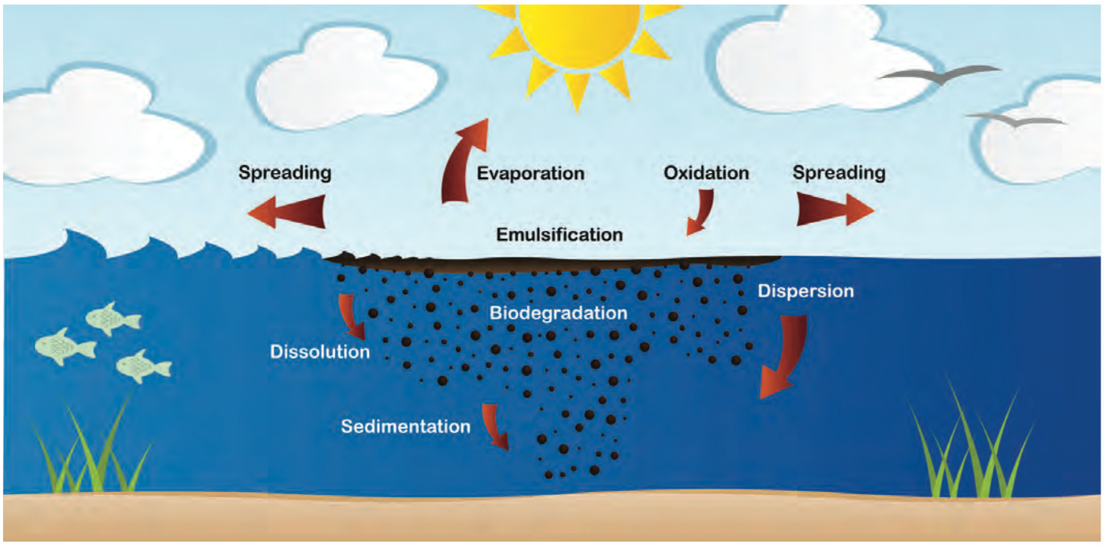

Figure 11: Oil spill weathering processes in water (ITOPF, 2011e). Figure used with permission.

2.3.2.1 Spreading

As soon as oil is spilled, it will start to spread out over the sea surface (Kingston, 2002). The speed of the spreading depends on the viscosity and the volume of the oil, and waves, turbulence, tides, and currents. Light and fluid oil will generally spread faster than heavy and thick oils, but spreading is far from uniform. As the oil spreads, it changes colour from black or dark brown to iridescent and silver, and fragments into patches. In open water, wind tends to cause oil spills to form bands parallel to the wind direction.

2.3.2.2 Evaporation

The lightest and most volatile components of the oil will evaporate within a few minutes (Kingston, 2002). The rate of evaporation depends primarily on temperature, but sea state and wind also contribute. The greater the proportion of compounds with low boiling points, for example carbon molecules with only a few carbon atoms, the greater the evaporation. The spreading rate of the oil also affects evaporation, as the rate of evaporation is proportional to the surface area. Spills of refined products, such as diesel and kerosene, may evaporate completely within a few hours. This evaporation of light components may cause human health hazards (Janjua et al., 2006) and increase risk of fire and explosion in confined areas (ITOPF, 2011e).

2.3.2.3 Dispersion

The rate of dispersion depends on the properties of the oil and the sea state (API, 2013e; Kingston, 2002; Wang et al., 2003). Low viscosity oil in the presence of breaking waves will disperse fast. Wave action at the surface will break up the oil slick into droplets of varying sizes and mix them into the water column. Smaller droplets tend to remain in the water and larger drops may rise back to the surface, where they could reaggregate into larger slicks or spread into a thin film. The dispersed oil mixes into increasing volumes of water, resulting in rapid reduction of oil concentration. The increased surface area presented by the oil droplets enhances the effect of other processes, such as biodegradation, dissolution, and sedimentation.

Applying dispersants may speed up this process, if applied within a narrow window of opportunity, before the oil becomes emulsified. However, viscous oils tend to not disperse at all, even with dispersants. In Sweden, the Coast Guard vessels have equipment to apply dispersants. However, as this practice is discouraged by the Helsinki Commission (HELCOM, 2013a), dispersants are in practice not used in the Baltic Sea or on the west coast.

2.3.2.4 Emulsification

Oil in water tends to absorb water and form what is called water-in-oil emulsion, sometimes referred to as mousse or chocolate mousse because of its colour and consistency (Daling, Moldestad, Johansen, Lewis, & Rødal, 2003; Kingston, 2002). Mousse can increase the volume of oil by up to five times. Thick, viscous oils tend to take up water more slowly. The asphaltene compounds can coat the water droplets in the emulsion and increase stability. Stable emulsions may contain as much as 70% water and are often semi-solid, have a brown orange or yellow colour, and are highly persistent (Daling et al., 2003). Less stable emulsions can separate into oil and water under calm conditions or when heated by sunlight. Formation of emulsions reduces the rate of other weathering processes and is the main reason for the persistence of light and medium crude oils on the surface or on shore.

2.3.2.5 Dissolution

The rate and extent of dissolution of hydrocarbon molecules in water depends on the composition of the oil, dispersion, water temperature, wave action, and spreading. Heavy oil molecules are virtually insoluble in seawater, while lighter molecules may dissolve (Kingston, 2002). However, lighter compounds are also volatile and evaporate 10 to 1,000 times faster than they dissolve. Thus, dissolved hydrocarbons in seawater rarely exceed 1 ppm and dissolution is not an important factor for oil spill mass balance calculations.

2.3.2.6 Photo-oxidation

Hydrocarbons can react with oxygen under the influence of sunlight, either leading to the formation of persistent tars or soluble products ("Environmental Implications of Oil Spills from Shipping Accidents," 2010; ITOPF, 2011e; Kingston, 2002). However, the effect of photo-oxidation is minor compared to other weathering processes. Thick layers of viscous oil or emulsions tend to oxidise and form persistent residues instead of degrading. This can be observed in tar balls that wash up on shore after an oil spill, which consist of a solid outer crust of oxidised oil and sediment, and a softer and less weathered core.

2.3.2.7 Sedimentation

Dispersed oil droplets can interact with organic matter and sediment particles in the water column, until the droplets become heavy enough to sink to the sea floor (Kingston, 2002). Water columns rich in suspended particles, such as river mouths and estuaries, provide favourable conditions for sedimentation of oil droplets.

Microorganisms may also ingest oil, which will then sink to the seafloor as excreted faecal pellets. Most oils are lighter than water and will remain afloat, but will sink if sediment is attached. Some oils will sink if burned, since the fire will consume the lighter components and create heavier pyrogenic products. In rough seas, denser oil can be found just below the sea surface, masking its presence from observations by ship or aircraft. Sedimentation is one of the long-term processes that lead to accumulation of spilled oil in the marine environment.

2.3.2.8 Shore interaction

Oil interaction with the shore depends primarily on the substrate and the wave exposure (Kingston, 2002). Sinking is often the result on sandy beaches, where the sand and oil are mixed together by wave action (API, 2009). Seasonal cycles of sediment build up can result in oil layers to be buried and uncovered. Often, the heavy sand and oil mixture is washed off the beach into the near-shore water, where this mix separates in the water column. The sand sinks to the bottom and the oil washes up on the shore again, to be mixed with new sand. Oil can also be trampled into the ground, for example by workers during a clean-up.

Muddy shores and marshes are common on shores with low wave energy (API, 2013f; NRT, 2010; Zhu, Venosa, Suidan, & Lee, 2004). Oil does not usually penetrate into these fine sediments, but remains on the surface. However, burrowing animals may dig holes, which may cause less viscous oils to penetrate deeper into the ground (Jewett et al., 2002). Oil can also be incorporated into fine grain sediments during storms, where fine mud particles are suspended in water and mixed with the oil droplets, before settling into the sediment as the storm abates. In sheltered areas contaminated sediments may remain for long periods of time without any degradation taking place (Wang et al., 2001).

On sheltered pebble and shingle shores and on rocky shores with cliffs and plattforms, high viscosity oils can form dense asphalt pavements when the surface layer of the oil oxidises. These asphalt pavements may persist for decades if left undisturbed (Wang et al., 2001). Floating oil can penetrate readily between the shingles, under rocks, and into crevices and is then protected from sea action and weather. This makes oil spills in this environment difficult and time consuming to clean up.

2.3.2.9 Biodegradation

Seawater contains a wide range of micro-organisms that are capable of metabolising oil compounds, such as bacteria, moulds, yeasts, fungi, algae, and protozoa (Brakstad & Bonaunet, 2006; Kingston, 2002; Pritchard, 1991; Sugiura et al., 1996). These organisms are present in seawater everywhere, but are more common in areas with natural seeps or chronically polluted waters, for example near urban centres or industry discharges. The main factors affecting the rate and extent of biodegradation are the microorganism composition and numbers, temperature, access to nitrogen, phosphorous and oxygen, and the characteristics of the oil, which vary tremendously. The end products of biodegradation are carbon dioxide and water. Once the biodegradation process begins, the organism community will develop and expand rapidly until it is limited by nutrients or oxygen deficiency. The smaller molecules are generally consumed faster and some of the largest molecules are broken down very slowly.

2.3.3 Environmental impacts

Environmental impacts of oil spills are well documented in the literature (Elmgren et al., 1983; Gehle, 2009; Kingston, 2002; Lerda, 2010; Lindén, Elmgren, & Boehm, 1979; F. J. Lindgren, 2012; NRC, 2003; Peterson et al., 2003; Smith, 1968). In general, the marine environment has a strong capacity to recover naturally from single events of environmental damage, such as that caused by occasional oil spills (Lindén et al., 1979; Martinsson & Fejes, 2007; NRC, 2003). The primary cause of damage to the environment is through acute toxicity and through smothering (NRC, 2003). The damage itself is dependent on the type of oil spilled (Lindén, 1976) and how quickly it disperses from the sensitive areas and organisms (Bowyer et al., 2003; Moreira, Moreira-Santos, Ribeiro, & Guilhermino, 2004; Peteiro, Labarta, &

Fernández-Reiriz, 2007). The most vulnerable organisms are sessile and therefore cannot move out of the way of an oil spill (F. J. Lindgren, Hassellöv, & Dahllöf, 2012a). Saltmarshes and mangrove areas are considered the most sensitive habitats (Baker, 1982; Chan & Baba, 2009; Lindén & Pålsson, 2013; Wang et al., 2001; Zhu, Venosa, Suidan, & Lee, 2001). Seabirds are also particularly at risk, since they may be drawn to the calm areas that oil slicks can generate on the sea surface (Camphuysen & Heubeck, 2001; Heubeck et al., 2003; Kingston, 2002; Wolfaardt, Underhill, Altwegg, Visagie, & Williams, 2008). This could have a lesser or greater impact on the bird population as a whole, depending on factors such as how many birds are impacted and species vulnerability. Some oiled birds may not survive for long when released back into the wild after cleaning or may have difficulty breeding successfully, depending on the species. Short-term environmental impacts can be severe, but long-term damage is uncommon, unless specific factors allow the oil to remain (Herkül & Kotta, 2012; Jewett et al., 2002; Singsaas & Lewis, 2011; Wang et al., 2001). Oil spill contamination can persist for several years after an oil spill in cold areas or encased in ice (Jewett et al., 2002; Wang et al., 2001), and areas of salt marshes or mangrove swamps even for decades (Kingston, 2002). In warmer climates, natural degradation of the oil is relatively fast and the environment may be restored within a few years and even faster if the worst of the oil has been cleaned up.

However, an oil spill at a unfavourable time of the year could potentially affect the majority of a population of a vulnerable or endangered species (Kingston, 2002; K. Larsson & Tydén, 2005). For example, the *Treasure* oil spill in South Africa in June 2000, impacted the endemic population of African penguins, *Spheniscus demersus*, categorised as vulnerable on the International Union for Conservation of Nature (IUCN) Red List of Threatened Species (Crawford et al., 2000; Wolfaardt et al., 2008). The spill oiled over 19,000 birds when it occurred between Dassen and Robben islands, which supported the largest and third largest colony of African penguins at the time, and accounted for about 40% of the total population. In this case, approximately 90% of the penguins survived rehabilitation (Wolfaardt et al., 2008), but for non-penguin bird species, the survival rate may be much lower (IPIECA, 2004a; WWF, 2006). Proper planning, training, equipment, and timely response will increase this survival rate dramatically. The birds are primarily affected through poisoning or choking when ingesting oil during preening, or freezing or starvation as the oil disrupts the insulating effect of the feathers and the birds need to invest a substantial amount of time to preen themselves, instead of foraging for food (Heubeck et al., 2003; K. Larsson & Tydén, 2011).

The Baltic Sea has some 4.4 million wintering birds according to an estimation from 2007-2009 (Skov et al., 2011). Of these, the Long-tailed Duck (*Clangula hyemalis*) stands out, as more than 90% of the European population spend the winters congregating around the Natura 2000 area Hoburgs Bank (area 28 in Figure 12) and the Middle Banks (areas 29 and 30), south of the largest Swedish island Gotland (Skov et al., 2011).

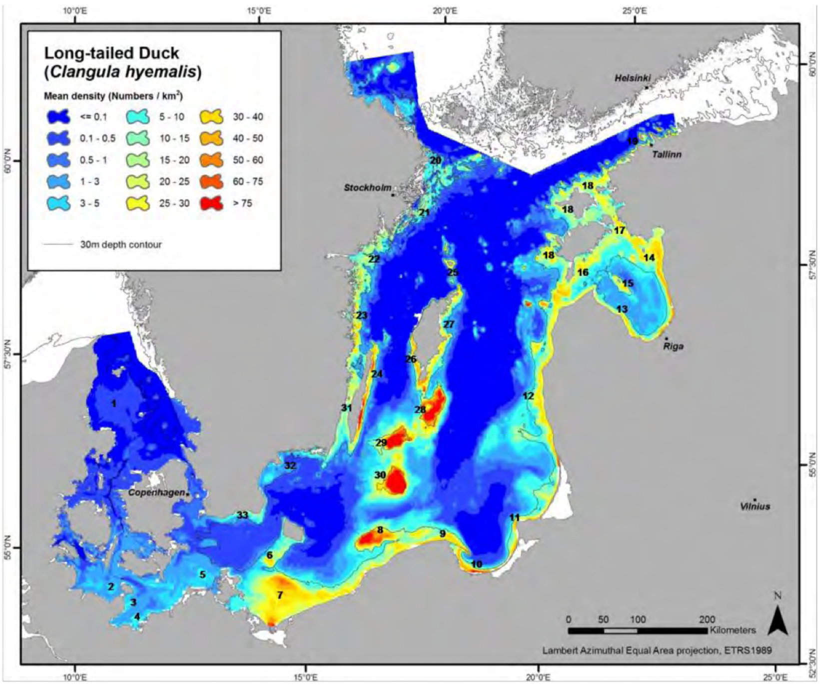

Figure 12: Distribution of wintering Long-tailed Duck (*Clangula hyemalis*) in the Baltic Sea, congregating around Hoburgs Bank (28) and the Middle Banks (29 and 30) (Skov et al., 2011).

These banks are also busy shipping areas and a large oil spill impacting the wintering seabirds could have a devastating effect on this vulnerable population. There is no correlation between the amount of oiled birds and the number of reported oil spills in Swedish waters, nor with the number of oil spills observed with aerial surveillance in the Baltic Sea (K. Larsson & Tydén, 2005; 2011). The authors concluded that these data are insufficient to estimate the impact of oil spills on the wintering birds.

2.3.4 Economic impacts

In addition to the clean-up costs, the economic impact on sectors that rely on a clean ocean and beach may be substantial. Commonly, the most impacted sectors are fisheries and tourism, although other interests, such as aquaculture, power plants, shipping, and various industries are also affected. Several studies have been carried out to investigate different factors associated with the cost of oil spills (Etkin, 2000; 2003; Forsman, 2007b; Montewka, Weckström, & Kujala, 2013; Tegeback & Hasselström, 2012; Yamada, 2009). The type of oil, volume of spill, and location of the spill are the most influencing factors for oil spill cost and only a relatively scattered linear correlation exists with the volume spilled (Yamada, 2009).

Two examples of economic impacts of oil spills are the *Prestige* accident in Spain 2002 and the *Deepwater Horizon* accident in the Gulf of Mexico in 2010. *Prestige* has so far generated 120.6 million EUR in compensation costs, with final admissible claims estimated to be 573 million EUR (IOPC Funds, 2014). Although not originating from shipping, oil spills from oil rigs may also impact Sweden, as Polish oil extraction from its three Baltic Sea oil rigs is planned to double during 2015 (PAP, 2014). BP paid a total of 20.8 billion USD for civil claims for the *Deepwater Horizon* oil spill in the United States in 2010 (DOJ, 2015). This is in addition to 4 billion USD in criminal fines, penalties, and restitution paid before. Additionally, BP has entered into separate agreements to pay $4.9 billion to the five Gulf States and up to a total of $1 billion to hundreds of local governmental bodies to settle claims for oil spill related economic damage. This illustrates the astronomical sums clean-up and compensation claims can reach for oil spills. However, these claims most often become highly political when the oil spill gets covered by the media, as in the case of both *Prestige* and *Deepwater Horizon*, and are often not directly tied to any scientific assessments.

2.4 Physiographic characteristics

Sweden is surrounded by the Baltic Sea to the east and the North Sea to the west. The Baltic Sea covers around 415,000 km^2 and is one of the largest brackish water bodies in the world (Saundry, 2013). It connects to the northeast Atlantic Ocean through the North Sea and via the Skaw (Skagerrak), Kattegat, the Danish Belt straits, and the Sound between Denmark and Sweden. It is divided into the Gulf of Bothnia in the north, the Gulf of Finland in the east, and the Baltic Proper in the center (see Figure 13).

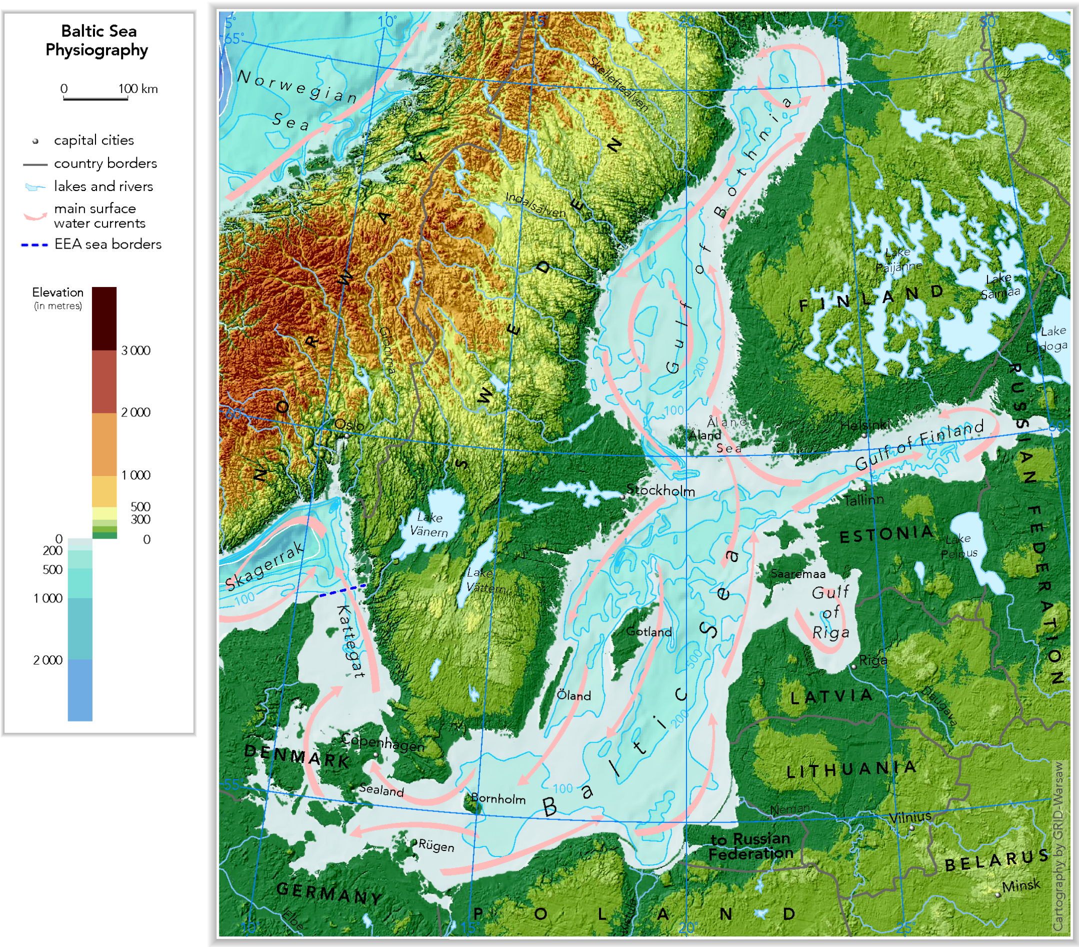

Figure 13: Baltic Sea physiography, showing bathymetry and currents (EEA, 2009).

The Baltic Sea is very shallow. The average depth is 56 meters and the deepest point, Landsortsdjupet, reaches 459 meters, which can be compared to the average depth of the world's oceans at 3,500 m (Saundry, 2013).

There are no noticeable permanent currents in the Baltic Sea, but the Skagerrak and Kattegat currents on the Swedish west coast are more permanent (see Figure 13). An outstanding feature of the Baltic Sea is the very large influx of fresh water into the basin. The lighter, less saline water from the Baltic Sea is transported as a surface current out through the Danish Belt Straits and the Sound (EEA, 2009). Heavier, saline water flows in the opposite direction close to the bottom into the Baltic Sea from the North Sea. Major in-flows only happen when persistent strong westerly winds prevail, historically once every 10 to 20 years. This creates a permanent halocline in the Baltic Sea, which prevents horizontal mixing. Salinity ranges from 3-4‰ in the northern part of the Gulf of Bothnia to 6-9‰ in the Baltic Proper and 15-30‰ on the west coast (SMHI, 2009).

The tidal range around Sweden is very narrow. On the west coast, Skagerrak has around 10 cm and Kattegat 5 cm (up to 40 cm and 20 cm respectively during spring tides) (SMHI, 2013). On the east coast, the Baltic Sea can experience local elevations of low amplitude, caused by very weak tidal forces reinforced by strong winds etc.

Sea ice in the Baltic Sea varies between the north and the south. The ice cover usually starts in the north of the Gulf of Bothnia in November and covers between 10 and 100% of the Baltic Sea (Jevrejeva et al., 2004). The length of the ice season is between 4 to 7 months and the landfast ice thickness is between 50 and 120 cm. The ice remains longest in the gulfs of Bothnia, Riga, and Finland.

The Swedish mainland coastline is around 11,500 km and the shorelines of the islands measure 31,900 km (SCB, 2002). There is no definition of the coastline in Swedish law. The coastline is instead defined and revised in the detailed municipal planning process for property purposes (LantmäterietSKL, 2015). However, there is continuous work on a national coastline definition (LantmäterietSjöfartsverket, 2003). The Swedish coastline is emerging isostatically by about 1 cm per year in the north down to 0 cm in the south, after the latest ice age receded 10,000 years ago (SMHI, 2009). The coastline varies tremendously around Sweden, with rocky cliffs, wetlands, archipelagos, and sandy beaches on both the saline west coast and brackish east coast (HELCOM, 2007b).

2.5 Anthropogenic vulnerability

The Baltic Sea borders nine countries: Denmark, Estonia, Finland, Germany, Latvia, Lithuania, Poland, Russia, and Sweden. All of these countries, except Russia, are part of the EU. Around 85 million people live in the catchment area of the Baltic Sea, most of them in the southern half. Besides these nine countries, another five (Belarus, Czech Republic, Norway, Slovakia, and Ukraine) contribute to the river runoff into the Baltic Sea. On the west coast, Sweden borders Norway and connects to the Atlantic Ocean through the North Sea and Kattegat. Kattegat is included in the HELCOM definition of the Baltic Sea, although it is usually not considered to be part of the Baltic Sea, which is generally considered to end around the Danish Belt straits and the Sound.

The large input of nutrients and organic matter from the Baltic Sea drainage area, enhanced by the limited influx of oxygenated saline water and the lack of mixing across the halocline, has led to eutrophication and severe oxygen depletion over significant portions of the bottom (HELCOM, 2011a). The lack of oxygen prevents any form of higher life, resulting in lifeless deep-water areas of, at times, up to 40% of the Baltic Sea (Havsmiljöinstitutet, 2014; Jutterström, Andersson, Omstedt, & Malmaeus, 2014). The brackish conditions and intense eutrophication mean that there are few species living in the Baltic Sea. Each species has a special ecosystem importance and the disappearance of a single key species could permanently change the whole system (HELCOM, 2003). There is a significant variation in the habitats and ecology along the Swedish coast, from hard susbstrate to eelgrass meadows, especially between the east and west coast (Havsmiljöinstitutet, 2014).

The Baltic Sea is becoming increasingly crowded with non-shipping related interests, for example marine protected areas, offshore wind farms, and aquaculture. It is estimated that the wind farms capacity will increase by from 4.2 Terawatt hours (TWh) to 29.3 TWh by 2030 (698%) using a central scenario, possibly up to 49.8 TWh (1,186%) using the highest scenario (EWEA, 2015). The Baltic Sea states are also much behind schedule in designating Baltic Sea Protected Areas (BSPA) (WWF, 2013). These new wind farms and marine protected areas could potentially change shipping patterns, depending on where these activities take place. Increasingly crowded shipping routes will slightly increase the risk of shipping accidents with potential oil spills, depending on location (DNV, 2007; MARIN, 2006).

The shallow, narrow Danish and Swedish straits connecting the Baltic with the North Sea and Atlantic Ocean are known from accident reports to be difficult and congested passages (HELCOM, 2014a). Most of the groundings occur in this area, while collisions are spread along the trade routes in the Baltic, in the high-risk areas (see Figure 14).

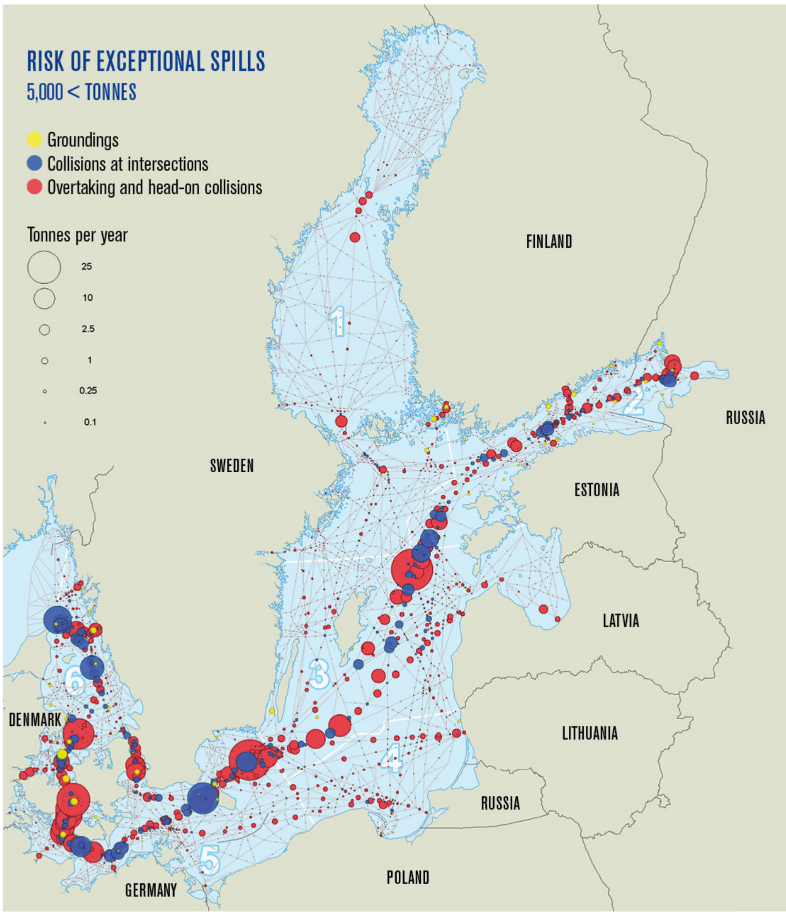

Figure 14: Risk of exceptional spills of more than 5,000 tonnes in the Baltic Sea (COWI, 2012c).

However, the steady number of accidents in recent years (see Figure 10) shows that severe oil spills are a real possibility, despite modern safety measures. The EU-funded project Sub-regional risk of spill of oil and hazardous substances in the Baltic

Sea (BRISK) estimated that an oil spill between 300 and 5,000 tonnes will occur every four years and an exceptionally large spill (5,000 tonnes and above) will occur once every 26 years (see Table 2) (BRISK, 2011; COWI, 2012c).

Table 2: Expected intervals between oil spill accidents in the Baltic Sea (BRISK, 2011).

Sub-region	Large accidents: 300-5.000 tonnes spilt	Exceptional accidents: 5,000 tonnes and above spilt
1. Gulf of Bothnia	36 years	600 years
2. Gulf of Finland	39 years	255 years
3. Northern Baltic Proper	30 years	175 years
4. South-eastern Baltic Proper	140 years	1,060 years
5. South-western Baltic Proper	17 years	97 years
7. Sound and Kattegat	11 years	65 years
Entire Baltic Sea	4 years	26 years

These expectations agree with the historic data in Table 1. However, there is a decreasing trend in the number of large oil spills during the last decade, but no decrease in the number of accidents (see Figure 10).

Sweden is not a large importer or exporter of oil compared to most Baltic Sea countries (see Table 3) (Eurostat, 2015a; 2015b; IEA, 2013).

Table 3: Oil import and export in the Baltic Sea Region and Norway 2013 (Russian export equivalent to oil turnover in the Gulf of Finland area) (Eurostat, 2015a; 2015b; PASP, 2015).

Oil import 2013 (million tonnes)		Oil export 2013 (million tonnes)	
Germany	127.9	Russia	128,7
Poland	27.9	Norway	75.8
Sweden	23.1	Germany	20.1
Finland	18.0	Denmark	13.3
Denmark	12.0	Sweden	10.1
Lithuania	10.1	Finland	9.2
Norway	6.1	Lithuania	8.5
Latvia	2.0	Poland	6.9
Estonia	1.1	Latvia	0.7
Russia	0.0	Estonia	0.8

However, the long coastline and extensive shipping around the Swedish coasts make them vulnerable to oil spills. Indeed, many countries that are not large oil importers (in the Baltic Sea, this applies to Finland and Estonia in addition to Sweden) may still be at risk from tankers and shipping traffic in transit to other destinations (Moller, Molloy, & Thomas, 2003).

2.6 Conclusion

This background chapter explained the current trade of oil, oil spill behaviour, and environmental and socioeconomic impacts.

Sweden has large archipelagos close to the major oil ports and many busy shipping lanes. However, the ships of today are much safer than 35 years ago, when the first large tanker oil spill occurred. International conventions are in place, vessel standards have improved, and crews are better trained. However, shipping has simultaneously increased, leading to congestion in narrow passages, such as those in the Baltic Sea. This makes it difficult to determine if the total risk has changed.

Few oil spills have occurred around Sweden, but this means that there is scant national experience in how to deal with oil spills. The low temperature and slow turnover of water in the Baltic Sea mean that the degradation of the oil will likely take a long time. A catastrophic oil spill could for example affect the large populations of wintering seabirds that are present in the Baltic Sea. A spill at an unfortunate time and place could potentially decimate entire populations and persist in the environment for years.

This dissertation analyses Swedish oil spill preparedness and examine trends existing in the current national capacity to handle large oil spills.

Chapter 3 - Literature Review

This chapter discusses oil spill preparedness in the literature. There are few academic references to general preparedness for oil spills, as most are focused on specific aspects of oil spill preparedness and response (Depellegrin, Blažauskas, & de Groot, 2010; Kuchin, 1999; Rådberg & Gyllenhammar, 2012; Taylor, Steen, Meza, Couzigou, Hodges, Miranda, Ramos, & Moyano, 2008a), tied to evaluations of specific oil spills (Cortez & Rowe, 2012; Kostka et al., 2011; Kurtz, 2008; National Commission on the BP Deepwater Horizon Oil Spill and Offshore Drilling, 2010), or to geographic areas (Bonsdorff, 1981; Ivanova, 2011; Pålsson, Olsson, & Lindén, 2012). Experts agree that greater effectiveness of oil spill response can be achieved with sufficient preparation (IPIECA, 2004a; 2007; ITOPF, 2011b; Kirby & Law, 2010).

3.1 Swedish literature

In the Swedish context, most of the research on oil spills was conducted in the 1970s and 1980s after the 1977 *Tsesis* oil spill outside Nynäshamn, south of Stockholm (Elmgren et al., 1983; S. Johansson, Larsson, & Boehm, 1980; Lindén et al., 1979; Norrby et al., 1979). Much of this research was focussed on ecotoxicology and environmental effects, and not oil spill preparedness management. The studies were opportunistic, since it was one of the first major oil spills in Sweden and occurred about 4 km from the Stockholm University field station Askö Laboratory. Established in 1961, Askö Laboratory had a good baseline dataset of the surrounding area to compare effects to, which is not usually the case after oil spill accidents. Because few large oil spill accidents have taken place in Sweden, limited research has been conducted on this topic. In the wake of the *Tsesis* accident, a governmental investigation reviewed Swedish oil spill preparedness (Norrby et al., 1979) and found it in need of improvement. However, this report focussed on organisational issues and not on contingency planning and response. The report recommended, among other things, that the Swedish Coast Guard (SCG) should merge with the

Swedish Maritime Administration (SMA) and create a new agency, which should be responsible for oil spills, and the County Administrative Boards (CABs) should be responsible for regional contingency planning. Many recommendations in this report are still valid, for example the need for coordinated monitoring after oil spills and the creation of an oil spill fund. The recommendations led to the formation of an inter-agency oil spill task force (today called the National Cooperation Group for Oil Combating, NSO) and regional equipment depots. This illustrates how oil spill preparedness became prioritised after the *Tsesis* oil spill. However, not all recommendations were implemented, despite the formation of a comprehensive funding programme for oil spill projects named TOBOS (Teknik for oljebekämpning till sjöss samt bekämpning och sanering av olja i strandzonen), which funded the research for several years (*TOBOS*, 1990).

Södertörn University in Huddinge published three papers related to the EU project Environmental Risk Governance of the Baltic Sea (RISKGOV), examining risk governance in the late 2000s. These papers examined the Swedish role as a pro-active country in making regional agreements (Hassler, 2008; 2010; 2011). They particularly examined how these agreements improved the implementation of international conventions and the mechanisms used to increase marine environmental protection in the Baltic Sea Region. However, these papers do not specifically discuss oil spill contingency planning or response, and merely highlight the benefits of being part of regional and multilateral agreements. A missing discussion in these papers concern whether there can be too many agreements, which could potentially create unnecessary administration and confusion.

Current research at Chalmers University of Technology in Gothenburg in relation to the project Development of a protocol for risk assessment of potentially polluting shipwrecks in Scandinavian waters (VRAKA), analyses chronic oil leaks from wrecks and their ecologic impact. The risk management is tied to removing oil from submerged vessels to prevent further environmental damage (Landquist, Hassellöv, Rosén, Lindgren, & Dahllöf, 2013; Landquist et al., 2014). Part of this research has analysed the environmental impact of chronic oil spills and found it to lower the activity and alter the composition of the meiofauna community (F. J. Lindgren, 2012; F. J. Lindgren, Hassellöv, & Dahllöf, 2012a; 2012b). There are fewer literature sources analysing ecological effects, in contrast to the physical and toxicological effects.

Current research at Kalmar Maritime Academy at Linnaeus University is focused on operational spills and seafarer motivation, but is not yet published in any papers (Hammander, 2015).

3.2 Oil spill management

Oil spill management in this dissertation primarily discusses *organisation* of the preparedness: the structure, means of communication, and division of responsibility between the organisations. These are measures to harmonise workflows, ensure cooperation, and ensure that prevention, planning, and response work as smoothly as possible. These factors are analysed in Chapter 5.

Several studies have been made on network theory and its inherent characteristics (Goldsborough et al., 2011; Newman, 2003; Sandström, 2008). However, studies on the coordination of human networks usually present models built on stable working relationships. These stable relationships are of less use for emergency response management (Hossain & Kuti, 2010), for example during an oil spill response operations.

In the Swedish context, Ödlund (2007) argues that attitudes towards cooperation in crisis management are in flux and changing towards a more collective approach. Many studies have been performed in recent years, for example through the project *Ledning och Samverkan* (LOS), meaning Management and Cooperation, which was conducted between 2012 and 2014. These studies identified a number of issues related to general crisis management (Danielsson & Larsson, 2011; Danielsson, Johansson, & Eliasson, 2011; Danielsson, Johansson, & Kvarnlof, 2013; Danielsson et al., 2012; MSB, 2013a; 2014). The authors found that there is a knowledge gap in how to organise and manage larger response operations, how to accommodate the expanded organisation, and how to manage volunteer organisations (Danielsson et al., 2013). This critique is also highlighted in the evaluation of the forest fire response in Sweden during 2014, criticising the management system for not being able to cope with a large response (Sjökvist, 2015). The advantages and disadvantages of improvisation were also discussed, as was the need for a common situational awareness and the difficulty in communicating situational awareness to everyone involved. In a large study comparing twenty different exercise evaluations, results show that each organisation performed its dedicated task and communicated well with the public (MSB, 2013a). However, there were deficiencies in knowledge, contact, dialogue, structure, clearness, analysis, and crisis communication within and between organisations. The analysis is difficult, because the different evaluations have different criteria for describing deficiencies. However, these deficiencies should be addressed to enhance the cooperation among the involved organisations.

Oil spills involve a lot of different organisations and bring together many stakeholders that have very little regular interaction, which makes oil spill response even more challenging.

3.3 Oil spill prevention

Oil spill prevention in this dissertation refers to political preparatory and mitigating measures at the national or international level, such as international conventions, industry standards, and national legislation. These factors are analysed at national, regional, and local scales in Chapter 6. The measures are set in place *before* an accident occurs, to minimise the risk of an oil spill occurring. It does not include prevention measures, such as oil spill contingency plans and local sensitivity atlases, which are analysed under planning measures in Chapter 7.

The role of the central government is critical in encouraging preparedness at various levels, by coordinating efforts and providing financial support (Tierney, 1993). Governmental engagement will impact the priorities of the national agencies, specifically through budgets and instructions to the agencies. This will often reflect the media coverage and public opinion, for example the massive media engagement and subsequent political engagement in oil spill response and offshore drilling following the *Deepwater Horizon* and the intense public and political pressure on the agencies to act (Allen, 2010). Communicating risk and effect to the public and thereby also to the politicians and authorities is extremely difficult (Allen, 2010; Alvinius, Danielsson, & Larsson, 2010).

For oil spill prevention, this political commitment can for example be ratification of international conventions or signing of international agreements concerning oil spill preparedness. Sweden is an active member of the United Nations (UN) and its maritime agency, the International Maritime Organization (IMO), and has signed most of the IMO Conventions. Concerning oil spills, the most important conventions for oil spill preparedness are:

- United Nations Convention on the Law of the Sea of 1982 (UNCLOS), is widely recognised as the constitution of the oceans (UN, 2001). UNCLOS has been ratified by a majority of the UN Member States. The convention deals with a multitude of issues in maritime and marine affairs, including accidents resulting in discharges of hazardous substances into the oceans. Sweden ratified the convention on 25 June 1996.

- The International Convention for the Prevention of Pollution from Ships, 1973/1978, or MARPOL, is the international convention covering the prevention of operational or accidental pollution of the marine environment by ships (IMO, 1978). It is a combination of two conventions and has been updated by amendments through the years. Sweden signed MARPOL on 9 June 1980 and ratified it on 2 October 1983.

- The International Convention Relating to Intervention on the High Seas in Cases of Oil Pollution Casualties, or Intervention Convention regulates if, and which, measures Coastal States can take on the High Seas to be able to prevent, mitigate or eliminate any danger from oil pollution to the coastline or other interests after a maritime accident (UN, 1969). It was adopted on 29 November 1969 and entered into force on 6 May 1975. The Intervention Convention applies to all seagoing vessels, except warships or non-commercial State owned vessels.

- The original convention concerning compensation for oil spill damage was the International Convention on Civil Liability for Oil Pollution Damage, 1969 (CLC Convention) and the International Convention on the Establishment of an International Fund for Compensation for Oil Pollution Damage, 1971 (FUND Convention). Both the 1969 and 1971 Conventions were revised in 1992 by adopting two Protocols and these revisions are known as the 1992 Civil Liability Convention and the 1992 Fund Convention (IOPC Funds, 2011; Jacobsson, 2007). They were adopted on 27 November 1992 and entered into force on 30 May 1996 and have been an incentive for several oil spill preparedness initiatives (Jacobsson, 2012).

However, the ratification of a convention does not necessarily equal enforcement of it. Knudsen and Hassler (2011) showed that even if IMO sets international regulations for its Member States, it is the national administrations' task to implement them. These national administrations may interpret the regulations differently and may have varying resources and working practices that influence the ratification. This creates differences in the level of implementation between different countries. Knapp and Franses (2009) presented a method to measure the effect of the various IMO Conventions on casualty rates by using an econometric model.

However, the analysis correlates significant effects only with a few of the conventions and amendments and the model fit is far from perfect in many cases, as pointed out by Knudsen (2011).

Sweden has been a member of the European Union (EU) since 1 January 1995 and is active within several of its policy areas. In October 2009, the EU approved the European Union Strategy for the Baltic Sea Region (EUSBSR) (EC, 2010). This strategy is the first plan in Europe covering a macro-region, and aims at reinforcing cooperation within the Baltic Sea. The EUSBSR contributes to major EU policies and reinforces integration within the area, which includes preparedness measures for oil spills.

Regionally, the oldest environmental organisation working exclusively with all the Baltic Sea countries is the Helsinki Commission (HELCOM). It is the governing body of the Convention on the Protection of the Marine Environment of the Baltic Sea Area (Helsinki Convention), the first regional convention to address the Baltic Sea (HELCOM, 2007a). The convention has its own Baltic Sea Action Plan (BSAP), also detailing measures for oil spill preparedness. A major difference between EU and HELCOM is that the Russian Federation is a member of HELCOM, the only Baltic Sea Region state that is not part of the EU. Additionally, whereas EU Regulations and Directives are binding law, HELCOM decisions are recommendations and it is up to each member state to decide to what extent, if at all, these recommendations will be adopted (Mitroussi, 2004).

Hassler (2008) argues that international conventions tend to suffer from the Lowest Common Denominator (LCD) effect. This means that the progression pace is determined by the least dedicated nations. Hassler argues that regional agreements may serve to complement international conventions, thereby reducing the negative LCD effects. He uses Sweden as an example of a pro-active country when it comes to mitigating oil spills and that regional initiatives help to negate LCD effects. The paper does not address the efficiency of the international conventions, nor the regional initiatives and does not offer any empirical measurements, which makes the claims reasonable, but hard to quantify. The effect of increased preparedness that is perceived could partially also be contributed to national and internal organisational development. In another paper, Hassler (2010) argues that bilateral and sub-regional initiatives may increase maritime safety, compared to exclusive reliance on international conventions. Sweden is active both in the international arena and regionally regarding oil spill preparedness, which was strongly encouraged in the governmental inquiry (Norrby et al., 1979) following the *Tsesis* oil spill in 1977.

3.4 Oil spill planning

Oil spill planning in this dissertation refers to the background knowledge and organisational measures, such as risk assessments, contingency planning, and increasing awareness. These are measures to *minimise* the negative impacts of oil spills. These factors are analysed in Chapter 7. It does not include training, which is analysed under response in Chapter 8.

There is a tendency to equate contingency planning with a written plan and believe that such a plan is evidence of preparedness (Perry & Lindell, 2003). In reality, planning is a continuous process and the contingency plan represents a specific point in time. A written plan in itself does not equate to being prepared. Preparedness is a dynamic and on-going process of which a written plan is an important part, but not a condition.

Oil spill contingency planning means to plan ahead for a future accident. An effective response to an oil spill depends on the preparedness of the organisations and individuals involved. The process of producing a contingency plan will provide opportunities to define division of responsibility, response strategies and operational procedures, as well as to identify necessary roles and responsibilities. By establishing a workflow and assigning tasks in advance, an organisation can test different scenarios and foresee bottlenecks and issues that will be problematic in a real incident. All the questions that will arise during the planning process should be addressed before a real incident. Most importantly, there is a need to exercise the plan, to see how it works and revise it accordingly.

In a review of disaster preparedness, Tierney (1993) stresses that preparedness activities must be based on correct assumptions about the post-disaster need and human behaviour. Quarantelli's general principles for good disaster planning, regardless of organisation (Quarantelli, 1982) is summarised by Tierney as:

- *"Planning is a continuous process. Planning does not consist of developing written plans, which are then considered "finished" rather, it is an ongoing process that involves a continuing effort to assess vulnerability and improve response capability.*

- *Planning involves attempting to reduce the unknowns in the anticipated disaster situation. No planning effort can anticipate everything that will occur when disaster strikes, but good plans can at least identify major problems that are expected and attempt to devise solutions. Because everything about a future disaster situation cannot possibly be known, it is impossible to pre-plan every aspect of the response, and flexibility is an absolute necessity.*

- *Planning aims at evoking appropriate actions. Rather than aiming at a rapid response, planning should emphasize acting correctly, even if that means doing nothing until adequate information is available. "It is far more important in a disaster to obtain valid information as to what is happening than it is to take immediate actions ... Planning, in fact, should help delay impulsive reactions".*

- *Planning should be based on what is likely to happen. While catastrophic and worst-case disasters do occur, preparedness efforts should focus first on disaster scenarios that are typical and probable. Plans should be based on empirically grounded assumptions about how members of the public will respond in emergency situations, rather than on "common sense" ideas or* *myths about disaster behavior. There is considerable continuity between how people behave during non-disaster times and how they behave in disasters. Rather than developing plans that require people to do things differently, planners should take this continuity into account.*

- *Planning must be based on valid knowledge. Three kinds of knowledge are critical: knowledge of how people are likely to respond in emergency situations; knowledge of the hazard itself and of associated vulnerabilities; and knowledge concerning the resources needed to respond to the hazard.*

- *Planning should focus on general principles. One reason for keeping plans focused on principles is that "a complex and detailed plan is generally forbidding to most potential users and tends to be ignored.". A second reason is that, since disaster situations shift and evolve rapidly, no plan can ever hope to cover all contingencies. Responding in a disaster situation always involves unexpected and unanticipated challenges, so plans must allow for flexibility.*

- *Planning is partly an educational activity. Good preparedness involves not only the development of plans but also efforts to ensure that all relevant community or societal sectors are brought into the planning process. The parties involved in the process must be educated on what the hazards are, how the plans will address the problems that are expected, and what their disaster roles will be.*

- *Planning always has to overcome resistance. The benefits that can be derived from preparedness activities are not self-evident. Disaster planning always requires some form of change in behavior, and change is often difficult to bring about. Government officials, business officials, and community residents have many priorities other than disaster planning, and societal and community needs are invariably greater than the resources that are available. Thus, getting preparedness measures developed, adopted, and accepted involves overcoming barriers that are often quite formidable.*

- *Planning must be tested. It is virtually a foregone conclusion that disaster plans that are not rehearsed and exercised will either not be used at all or will fail in an actual disaster situation. All types of coordinated action* *require rehearsal; this is especially true for the coordination that is needed following a disaster.*

- *Planning is not management. Disaster planning develops general principles and strategies for action during emergencies; emergency management attempts to apply those principles and strategies in the disaster setting. Because disasters always contain elements that are not anticipated in plans, the actions that are ultimately taken by managers may not be covered in any plan."*

These principles are very relevant to oil spill contingency planning and other authors have since elaborated and expanded on the work of Quarantelli. Perry and Lindell (2003) give an excellent and insightful discussion of the general principles. Tierney (1993) highlights that although types of disasters (floods, earthquakes, landslides) differ, planning should be generic and that the same general tasks will be needed in all of these disasters. Planning should be integrated, rather than fragmented; a holistic plan involving different organisations and governments is far more effective than each entity producing a disaster plan of their own. This corresponds to the idea and practice of the post-incident management tool used in the United States, called the Incident Command System (ICS). ICS has a general management structure for all emergencies, regardless of type, which all authorities and the industry should be familiar with. This system is used regularly in exercises where the authorities and industry train their personnel in their respective and compatible contingency plans (Cashman, Stephens, & Boyles, 2003).

The oil industry (IPIECA, 2007; ITOPF, 2011b; Taylor, Steen, Meza, Couzigou, Hodges, Miranda, Ramos, & Moyano, 2008b) and various governments have published several guidelines (ACS, 2012; Kulander, Ericsson, Tegeback, Fejes, & Evans, 2010; Nuka Research and Planning Group LLCPearson Consulting LLC, 2010; Sjöfartsverket, 2005) and oil spill contingency plans (Länsstyrelsen Hallands Län, 2011; Maritime Safety Queensland, 2014). There are no official rules for how to write an oil spill contingency plan. Different areas, organisations, and countries have different regulations and practices that must be taken into account. Hence, the general principles described by Tierney (1993) above are good guidelines and are, by design or coincidence, followed to a great extent by most practitioners. Several international preparedness organisations, both industry and governmental, have made efforts to harmonise all oil spill contingency plans through common guidelines and recommendations (API, 2013c; HELCOM, 2013b; Owens, Solsberg, West, & McGrath, 1998; Taylor & Lamarche, 2014; Taylor, Moyano, & Steen, 2014; Taylor, Steen, Meza, Couzigou, Hodges, Miranda, Ramos, & Moyano, 2008a; 2008b). However, the primary use of an oil spill contingency plan is the planning process itself, not the finished document. This can be illustrated by the Swedish case of Tjörn, which is an island on the west coast that was impacted by the oil spill from the *Golden Trader* accident off the Danish coast in 2011 (Dimming, 2012; Ghirxi, 2014; MSBHaV, 2014). The Tjörn municipality had an oil spill in 1987 and had an oil spill contingency plan updated in 2005 (Pålsson, Ericsson, & Olsson, 2011). However, as the plan had never been exercised, it was not even considered to be used during the oil spill response (MSBHaV, 2014).

In order to have sufficient knowledge to be able to develop a good contingency plan for an area, there is a need to carry out a risk assessment for oil spills and gather information about environmental sensitivity to oil spills. Much research has been done on risk assessments, mostly tied to specific areas (Arctic Council, 2009; Aseev et al., 2014; Hassler, 2011; Kirby & Law, 2010; Moller et al., 2003; Nuka Research and Planning Group LLCPearson Consulting LLC, 2010; Veiga, 2004). Sensitivity mapping is also a topic that has received a lot of attention, often in connection to risk assessments for other projects, for example establishment of wind farms (API, 2013f; IPIECA, 1994b; IPIECA, IMO, OGP, 2012; SL Ross Environmental Research Ltd., DF Dickins Associates LLC, Envision Planning Solutions Inc., 2010). This planning and risk assessment process raises the awareness of the people involved and creates an understanding of the issues, regardless of what the finished plan may look like.

In the Baltic Sea region, much work has been done by HELCOM (HELCOM, 2013a; 2013b) and in the last years primarily through several EU projects, for example BRISK, EnSaCo, and Baltic Master II. These projects have developed guidelines (Emmelin & Haglund, 2012; MSB, 2011; Pålsson, 2011; Pålsson & Nilsson, 2011), risk assessments (BRISK, 2011; Brunila & Storgård, 2012; COWI, 2012c; J. Johansson & Molitor, 2011; MSB, 2013b; Rådberg & Gyllenhammar, 2012; Staskiewicz, 2011; Viertola, 2013), and sensitivity maps (COWI, 2012a; Depellegrin et al., 2010; Forsman, 2012a; Lundius, 2011; Staskiewicz, 2011) to help the contingency planning process. In addition, the projects have worked with testing the plans during exercises (Forsman, 2012b; Ljungkvist, 2011; MSB, 2012). Much of the work within these projects has taken place in Sweden.

Pålsson and Wåhlander (2013) showed that 80 of the coastal municipalities in Sweden (61%) had an oil spill contingency plan, 14 did not have a plan (11%) and 38 did not respond (29%). Additionally, 66 municipalities (50%) responded that the plan had been revised during the last five years and 42 municipalities (32%) responded that the plan had been used during an exercise within the last five years. This is an improvement from a similar study in 2011 (Pålsson et al., 2011). However, this is still far below an ideal situation, where all municipalities have an oil spill contingency plan in place, and exercise and revise it regularly. However, as no regulations exist for the municipalities to have an oil spill contingency plan, no requirements exist for the municipalities for what needs to be included.

3.5 Oil spill response

Oil spill response in this dissertation refers to the training, equipment and methods used to clean up oil, and exercises. These are measures to make the response as *effective* as possible. These factors are analysed in Chapter 8. Much research has been done on oil spill response, and similar to the environmental and economic impacts, the focus has been on individual spills (Fagö, 1991; Jernelöv & Lindén, 1981; Kurtz, 2008; Maritime Safety Queensland, 2014; NOAA, 1992).

Like disaster preparedness, much research has been done in social science on disaster response, and more is known about this phase than others (Tierney, 1993). A key feature in disasters is that they generate extremely high demands for emergency equipment and personnel. In the case of oil spills, these could for example be booms, boats, storage sites, waste management, and response professionals. This demand is usually far above the normal capacity of the impacted area and affected organisations must adapt to this situation.

Good overviews of different response strategies (API, 2013g; 2013e; de Susanne & Peytavi, 2011; IPIECA, 2004b; 2004a; IPIECAOGP, 2012b; 2013b; ITOPF, 2011a; 2011c; 2011f), use of equipment (Cortez & Rowe, 2012; IPIECAOGP, 2012a; 2013a; ITOPF, 2011g; 2011h; 2012c; 2012d), and exercises (IPIECA, 1994a; NRT, 2014) can be found among industry and authorities. The several advantages of exercising plans and personnel is highlighted and discussed by several authors (e.g. (de Susanne & Peytavi, 2011; Forsman, 2012b; Køpenhavnsavtalet, 2015a; Ljungkvist, 2011; MSB, 2011; 2012; NRT, 2014; Pålsson et al., 2011; Perry, 2004).

Oil spill preparedness in the Baltic Sea Region countries is in various stages of development (Pålsson et al., 2012; Pålsson & Wåhlander, 2013). There are several conventions and agreements, for example HELCOM, BRISK, and the Copenhagen Agreement, that regulate cooperation across borders and between organisations. Past experiences from oil spills show that almost all oil spills at sea will affect land (Rylander, 2005). A weakness of existing plans, conventions, and agreements is that they are focused on oil spills at sea. Limited attention is directed at oil once it has come ashore. Furthermore, the development of onshore clean up technology has been very limited in the last decades (API, 2013a; 2013b; 2013d; Pålsson & Lindén, 2014a). HELCOM has recently expanded its focus from open sea response to include shoreline response to oil spills (HELCOM, 2013b). Shore response was made an integral part of the annual BALEX DELTA exercise for the first time in 2010

(HELCOM, 2014b). Oiled wildlife response has also been developed and was added to the HELCOM Response Manual in 2010 (HELCOM, 2011b).

In Sweden, oil spill response has been evaluated in a number of reports. After the *Tsesis* oil spill outside Nynäshamn in 1977, a detailed governmental investigation reviewed the contingency planning and response (Norrby et al., 1979) and reported that the response had been unnecessarily delayed because of communication and organisational issues, such as unclear division of responsibility and lack of liaison officers and communication radios. More recently, the Swedish Audit Agency conducted an audit in 2006 and came to the conclusion that preparedness in municipalities was inadequate, with few municipalities having sufficient response capacity, the national response resources and efforts had not been received by the municipalities, and there were still issues regarding the division of responsibilities (Riksrevisionen, 2006). Evaluations are conducted on the various exercises and spills in Sweden, for example after *Fu Shan Hai* in 2003 (Fejes et al., 2004; Ljungkvist, 2003), the international BOILEX exercise in 2011 (MSB, 2012), and the FSHex13 exercise in 2013 (Ljungkvist et al., 2013). The Swedish Civil Contingency Agency (MSB) and the Swedish Agency for Water and Marine Management (SwAM) initiated a comprehensive evaluation of the most recent large oil spill response in Sweden, i.e. *Golden Trader*, which impacted Tjörn 2011 (MSBHaV, 2014). Many deficiencies were identified and recommendations made, and are discussed in Chapter 8.

3.6 Conclusion

The literature review shows that there is a knowledge gap specific to oil spills and oil spill preparedness in Sweden since the *Tsesis* oil spill in 1977. This is true in all chosen topics: prevention, planning, response, and management. However, work has been done on disaster and crisis management related to natural disasters. A large body of grey literature exists on the topic of oil spill contingency planning and risk assessments. Qualitative research has primarily been examining management and assessing risk. The reasons for this may be because the involved authorities have limited interaction with the scientific community or that the topic has not been interesting enough for the academic world, with the few exceptions noted earlier. The distinct Swedish management structure with strong municipalities and national coordination, rather than national control, has not been analysed in the oil spill context.

Consequently, there is an academic need to fill the knowledge gaps in oil spill preparedness concerning the Swedish context. This dissertation responds to this need and gives insights into the current Swedish situation.

Chapter 4 - Methodology

This chapter presents the research context, scope, and rationale of this dissertation. The research approach, hypotheses, methods for data collection, methods for analysis explained are explained and justified, together with quality control and research ethics.

4.1 Research approach

The research questions were conceived through inductive reasoning and observation of the status of oil spill preparedness in Sweden. These questions were formulated during the initial data collection phase and continuously refined. This dissertation has been developed using an action research approach with Sweden as a case study. This was achieved by working concretely with oil spill preparedness through several projects, primarily the EU Baltic Sea Region project Baltic Master II, the United Nations Environment Programme (UNEP) project Environmental Assessment of Ogoniland, and the Swedish Institute (SI) and Swedish Civil Contingencies Agency (MSB) funded Baltic Maritime Science Park Oil Spill Forum (BMSP Oil Spill Forum).

4.1.1 Epistemology

The philosophy that has been adhered to in this dissertation is the post-positivist theory originally developed by Thomas Kuhn (1962) and expanded by Karl Popper (1994). This theory uses deductive reasoning, empirical evidence, and hypothesis testing to gather information (Trochim, 2006). This dissertation follows the critical realist philosophy in that it assumes that all observations have error and all theories can be revised. The assumption is that everyone is biased by culture, education, and general life experiences. The critical realist philosophy gave rise to the constructivist philosophy, where our view of the world is constructed based on our imperfect and biased perceptions. Consequently, a post-positivist constructivist believes that the best method to achieve objectivity is to triangulate data using multiple imperfect perspectives, which has been the methodological approach in this dissertation. This means that true objectivity and reality can never be achieved, but it can be approached. This pursuit of objectivity uses a community of scientific philosophers to critically scrutinise each theory and offer multiple perspectives. This is partly the philosophical basis for the article peer-review system used today.

This dissertation has strived for more credible findings by using multiple methods, investigative approaches, and other types of triangulation when collecting data. The research has drawn on the scientific disciplines of social science, disaster management, and network theory. This constructivist philosophy of emphasising the importance of multiple measures and observations using triangulation has been followed. The triangular approach is defined as the use of different research methods to study a single research problem (Olsen, 2004). Using this approach, the findings can show convergent results, despite an apparent lack of statistical certainty.

4.1.2 Action research

Action research refers to processes that involve intervention in organisations and procedures (Gummesson, 2000). It is a combination of research and management consultancy that involves intervention into processes of decision-making, implementation, and change. It has the dual purpose of advancing knowledge and improving or enhancing a practice in some way. Action research has a wide scope and varies in emphasis between practical transformation and advancement of general knowledge. Its origin goes back to the 1940s and it is also termed *action science*, *action inquiry,* and *action learning* (Perry & Lindell, 2003). It has been argued that to truly understand managerial processes and changes, it is beneficial to be part of the process, to be a *"change agent"* (Gummesson, 2006). Huxham (2003) states that:

"Action research is particularly appropriate for developing theory that relates closely to practice and is concerned with the process of managing."

With the action research approach, it is much easier for a researcher to intrude on on-going management processes. Assuming the role of an expert or consultant, the researcher has a legitimate reason for being involved in the process.

The advantage of this approach is that it provides the researcher with substantially improved access to individuals and to non-public material (Gummesson, 2000; Huxham & Vangen, 2003).

The disadvantage of this approach lies in balancing the roles of researcher and consultant (Gummesson, 2000). The researcher may become too involved in the process, to the point of being detrimental to the process itself. In contrast, a researcher can also end up personally driving the process, meaning that the process will stop as soon as the researcher leaves. Participation may also require too much attention, and the researcher will not have time to take adequate notes or consider different perspectives. The researcher must be aware of this bias and introduce mechanisms to control or quantify them.

Since this dissertation revolves around oil spill preparedness and its management, action research was the most logical approach. The author’s dual role as a researching PhD candidate and a research assistant working practically with projects, also made the action research approach the most logical to pursue. The main differences between this dissertation work and that described by Gummesson (2000), is that he describes situations where he was a consultant in one organisation and had more or less direct influence over organisation decisions. This dissertation examined oil spill preparedness in Sweden with no direct influence by the researcher on the organisations involved. Contrary to a company that spends time and money to hire a consultant to evaluate or facilitate a change, the organisations involved in Swedish oil spill preparedness may not want to or be able to change because of different reasons.

4.1.3 Case study

Case study research is one of several methods of social science research. It is the preferred method to use when the main research questions are "*How?*" and "*Why?*", when a researcher has little control over behavioural events, and where the focus of the study is a contemporary phenomenon (Yin, 2014). A case study represents a whole experiment, rather than merely a sample. This means that it is not trying to make any statistical generalisations of probabilities, but will analytically expand and generalise theories. Case study research in this dissertation is considered a research approach rather than a research method. This is because case study research is interpreted as a method covering the research topic as a whole, not just data collection techniques. Case study research shares similarities with the historian's approach to research in that it relies on existing documentation of events. But in contrast, the case study researcher may have access to direct observations of the phenomenon and is able to interview persons involved in the events.

Yin (2014) defines the scope of the case study as:

"…an empirical inquiry that

- *investigates a contemporary phenomenon (the "case") in depth and within its real-world context, especially when*
- *the boundaries between phenomenon and context may not be clearly evident."*

Yin goes on to define the features of the case study as:

"A case study inquiry

- *copes with the technically distinctive situation in which there will be many more variables of interest than data points, and as one result*
- *relies on multiple sources of evidence, with data needing to converge in a triangulating fashion, and as another result*
- *benefits from the prior development of theoretical propositions to guide data collection and analysis."*

The definition and extent of a case study depends on the specific research questions and how they are formulated. This makes defining the units of analysis a problem and is closely related to identifying case study boundaries (Yin, 2014). It is therefore critical to identify spatial, temporal, and other case boundaries in the research design. This is true even if researching abstract arguments or hypotheses, which need to be concretely manifested and defined in a real case in order to be analysed.

What makes case study research more than just a form of qualitative research is the use of both quantitative and qualitative evidence (Yin, 2014), which has been adopted in this dissertation. This makes the research versatile and gives a strong incentive for the researcher to use different methods for triangulation, thus avoiding mono-method bias. Case study research is also well suited for describing common, critical, revelatory, or unique cases (Yin, 2014). The common case might try to capture the everyday situation to analyse theories on specific processes. The critical case might be used when a theory has a clear setup that will allow it to be tested using a single decisive case to prove or disprove the theory. The revelatory case might be observations of a situation previously inaccessible to science. A unique case might be a rare injury or disorder that can reveal insights about normal processes, or as in this dissertation, the specific situation in a country.

Criticism specifically regarding single case studies, such as used in this dissertation, concerns fears that the uniqueness of the case will make it difficult or impossible to generalise from and that there may be unique artifactual conditions surrounding each case (Yin, 2014). The concern on generalizability is eloquently addressed by Norman (1970):

"The possibilities to generalise from a single case study are founded in the comprehensiveness of the measurements which makes it possible to reach a fundamental understanding of the structure, process and driving forces rather than a superficial establishment of correlation and cause-effect relationships".

Generalisation can therefore be obtained if the measurements are well structured, which has been the aim of the research design in this dissertation. The artifactual conditions of a single case are inherent in the validity of the case study research, and should be controlled by the same measures that control the research validity. Another issue is that a case may not turn out to be the case originally thought because there are other influencing factors of which the researcher was unaware (Yin, 2014). Establishing a comprehensive understanding of the topic during the initial knowledge-gathering phase has controlled this issue.

The case study approach was the logical choice for this dissertation, since oil spill preparedness is a phenomenon outside of the control of the researcher and the focus is contemporary and aimed at a single country: Sweden. The case is unique because no studies have been found that have analysed oil spill preparedness in Sweden or its organisational network.

4.1.4 Dissertation approach

The work for this dissertation started using the action research approach with Sweden as the case study. However, this approach changed after the initial phase of the research ended with the Baltic Master II project. The relatively long knowledge-gathering phase meant that there was ample time to immerse in the oil spill preparedness topic, obtain access to data, and establish a comprehensive network of contacts. Gummesson (2000) argues that this immersion in a topic is necessary for what he calls the *"pre-understanding"* of a topic. The researcher is often able to list a great number of factors and relationships on a certain topic, while only having superficial knowledge them. The difficult part is to attach proper weight to these factors and relationships. The researcher may be unaware of the consequences of inadequate access and understanding. This may result in a focus on statistical analyses of weak data based on incorrect assumptions about the importance of various factors and relationships (Gummesson, 2000). Thus, an insufficient amount of time spent on gathering knowledge means that the work of the researcher becomes liable to serious shortcomings and may be misleading. For example, the researcher risks choosing an access method that fails to provide an opportunity for the informants to give relevant answers or erroneously believes that a popular method within management research is the correct method to use for the study. The best opportunity for researchers to develop sufficient understanding is to operate as active participants in a process, rather than as interviewers or detached observers. Gummesson's (2000) reasoning has been a guide for the research approach in this dissertation.

The practical work during the Baltic Master II project ranged from preparing and writing draft contingency plans (Pålsson, 2011; Pålsson & Nilsson, 2011), to observing, planning, and conducting exercises for various organisations in Sweden and Denmark. Reports on the level of preparedness for oil spills in the Baltic Sea region were also written (Pålsson et al., 2011; 2012). This provided an opportunity to be involved practically in the oil spill preparedness community in the Baltic Sea Region, and establish a network of contacts that was of great help during the data collection phase. Much information relevant to this dissertation and to theory formation was gathered during informal conversations with experts, observations during exercises, and interaction during conferences.

In an investigation of the oil contamination in the Niger Delta, field sampling of water and sediment was made in Ogoniland in Nigeria. The purpose of this was to assess the level of pollution that has arisen from oil spills (Lindén & Pålsson, 2013; Pålsson & Lindén, 2014b; UNEP, 2011). This was an opportunity to study a fundamentally different setting in depth and provide a perspective on the Swedish oil spill preparedness. Although not concerning Sweden directly, the situation in Nigeria highlighted the problems many countries have with oil spill preparedness and the implications of a failure to be prepared.

The data collection phase mainly coincided with the BMSP Oil Spill Forum project, during which the researcher's role changed from active participation to more of an observer. In this way, access and network contacts gained from the knowledge-gathering phase were maintained, but time was reallocated to dissertation data collection and writing. Further analysis of the state of oil spill preparedness in the Baltic Sea was made during the BMSP Oil Spill Forum project through project reports (Pålsson & Lindén, 2014a; Pålsson & Wåhlander, 2013). Analysis was possible after data collection through interviews, organising and participating in oil spill workshops in the Baltic Sea region, and continuous data collection as new sources were discovered. Much knowledge can be gathered through informal discussions during themed events such as workshops and conferences (Gummesson, 2000) and this was true during both Baltic Master II and BMSP Oil Spill Forum.

The social research approach is found to be similar to a criminal investigation in that evidence is collected from different sources, such as interrogations (interviews) of witnesses (informants), documentation (written information), and crime scene investigation (observations). With an increasing body of collected facts, theories evolve around suspects (involved organisations), motive (the *"Why?"*), and means (the *"How?"*). Each of these theories are then in turn falsified by evidence until the one true (or constructivist close to true) theory has been substantiated enough to hold up in a criminal court (peer-review), with overwhelming evidence triangulated from different perspectives.

4.2 Research design

The methodological approach was based on action research and the case study method following a post-positivist constructivist perspective. This approach was operationalised through a research design that first chose specific units of analysis and variables, and then appropriate methods of analysis in order to draw correct conclusions.

4.2.1 Aim

The aim of this dissertation is to better understand the state of oil spill preparedness in Sweden today and use the findings to recommend improvements. Oil spill preparedness refers to the ability to respond to oil spills and includes overall management, and the prevention, planning, and response parts. This is done by:

- Describing the Swedish oil spill preparedness regime.
- Analysing the current state of oil spill preparedness in Sweden.
- Analysing the cause of any deficiencies found.
- Use the findings to suggest improvements.

4.2.2 Scope

This Swedish oil spill preparedness case study focuses on overall management, and the prevention, planning, and response parts of oil spill preparedness. Oil spills refer to oil pollution from ships, pipelines, fixed installations, ports etc. Due to budget limitations, and laboratory and equipment access, the dissertation does not cover efficiency of practical operational response or evaluation of different oil spill clean-up techniques and strategies, except the operational management and organisation of response and exercises. Neither does the study evaluate individual oil spill contingency plans or liability issues. The organisations reviewed primarily represent the governmental agencies tied to the National Cooperation Group for Oil Combating (NSO). NSO consists of representatives from the Swedish Coast Guard (SCG), the Swedish Civil Contingencies Agency (MSB), the Swedish Agency for Marine and Water Management (SwAM), the Oil Spill Advisory Service (OSAS) at Sweco AB, the Swedish Maritime Administration (SMA), the Swedish Transport Agency (STA), the Swedish County Administrative Boards (CABs), and the Swedish Association of Local Authorities and Regions (SALAR).

The geographical scope is Swedish territorial waters and Exclusive Economic Zone (EEZ), including the nation's three largest lakes: Vänern, Vättern, and Mälaren, defined as state waters in national legislation (Sveriges Riksdag, 2003). The dissertation does not extend to spills on land, unless the spills end up in or originate from state waters. However, the Swedish role in international oil spill preparedness is included, for example through EU projects and work under international conventions and agreements through organisations such as the Arctic Council, the Helsinki Commission (HELCOM), and the International Maritime Organization (IMO).

The temporal limitations are developments made during the course of the research, i.e. between 2009 and 2015.

4.2.3 Oil Spill Preparedness model

Oil spill preparedness is a broad topic that is divided into many sub-topics in different ways by different authors. In order to structure the research and manage the topics, a framework concept model for oil spill preparedness was developed. This framework is an adaptation of work from the Baltic Master II project (Pålsson, 2011; Pålsson et al., 2012) which in turn is based on a comprehensive paper by Taylor et al. (2008b). The model was developed to conceptualise oil spill preparedness in order to subsequently operationalise the concepts and develop suitable units of analysis and variables.

4.2.3.1 Concept model

The Oil Spill Preparedness concept model was founded on three main pillars: Prevention, Planning, and Response (see Figure 15).

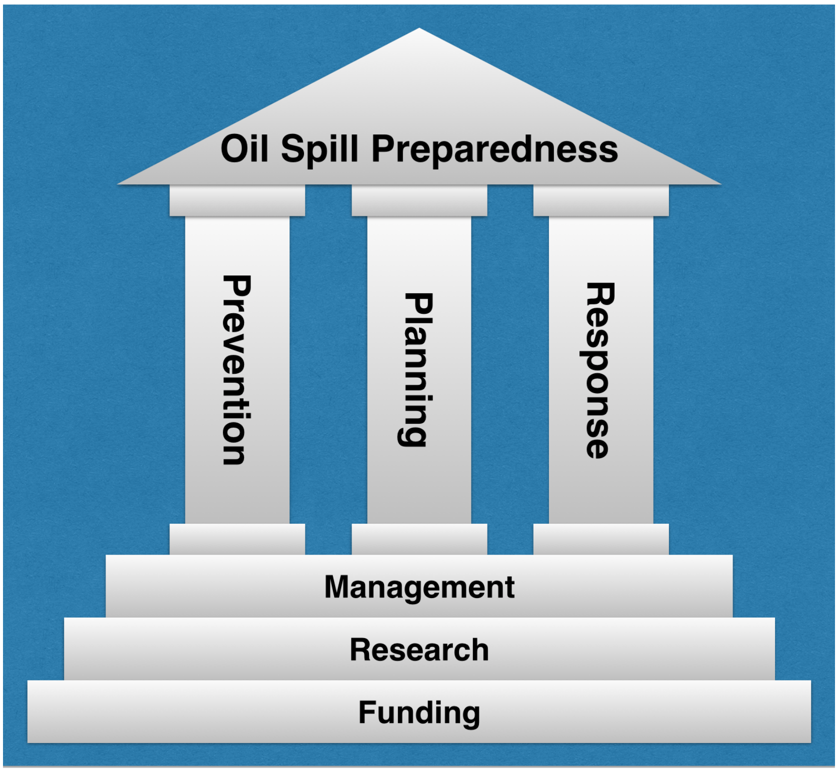

Figure 15: Oil Spill Preparedness concept model with three distinct pillars: Prevention, Planning, and Response, standing on a foundation of: Management, Research and Funding.

Foundational topics for all three pillars are: Management, Research, and Funding. These pillars and their management are the oil spill preparedness topics that have been analysed in the Swedish context. Analyses of research and funding are not substantial enough to have their own sections, as these are deeply linked to the different topics and have thus been embedded in the examination of the specific topics.

The three foundational topics are:

1. Management

Management supports the three pillars. In this dissertation, management is defined as governance of the organisations involved in the preparedness, organisational structure, means of communication, and division of responsibility among these organisations. Effective management will streamline workflows, ensure cooperation and make certain that the different actors function as smoothly as possible.

2. Research

Research is an underlying foundation for making the correct choices during oil spill planning and response. It involves knowledge of the fate and effect of oil spills, the behaviour of oil in the environment, and the effect this knowledge has on the decision-making and preparedness management. This topic is deeply embedded in all pillars and does not warrant its own section.

3. Funding

Funding is one of the foundation topics. There is basic funding for oil spill preparedness in Sweden, but the issue is how funding is directed, channelled, and utilised. As soon as an oil spill occurs, funding issues will have to be discussed and solved. Different countries and organisations have different strategic goals, with funds being earmarked for a specific task and some funds used at the discretion of the organisation. This topic is also deeply embedded in all pillars and does not warrant its own section.

The three pillars are:

1. Prevention

Prevention in this dissertation is defined as keeping an oil spill from happening by taking precautionary action, including setting up mitigating measures should an oil spill occur. This involves preventive measures on a national or international level, such as international conventions, industry standards, and national legislation. These are set in place before an accident occurs, in order to minimise the risk of an oil spill occurring and the negative impacts of an oil spill. Prevention also includes local prevention measures, such as local regulations, protocols, and voluntary procedures.

2. Planning

Planning in this dissertation is defined as knowledge of oil spills and its impacts and organisational measures, such as risk assessments, contingency planning, and awareness. Good planning will minimise the negative impacts of an oil spill, should it occur. These measures will involve several different organisations, which will approach the planning and the need for planning from different perspectives and with varying interest.

3. Response

Response in this dissertation is defined as cleaning up the oil with trained personnel, which equipment and methods should be used, and actually cleaning up the oil. These are prerequisites needed to make the response efficient. Response involves actions both before and after an oil spill occurs, such as training, health and safety, exercises, equipment depots, waste disposal, and logistics.

4.2.3.2 Model refinement

Different oil spill preparedness models were found in the literature and compared to the concept model.

1. Key Success Factors

Weber et al. (2001) designates Key Success Factors for preparedness and how to use them for a preparedness assessment system. The Key Success Factors are:

a) Stakeholder outreach and engagement.
b) Policy and doctrine.
c) Area Contingency Plan.
d) United States Coast Guard (USCG) capability.
e) Non-USCG capability.
f) Team training and exercises.

g) Evaluations (of exercises and response).

These factors are practically driven and are defined from the viewpoint of the USCG and the Federal On-Scene Commander (FOSC) role in the United States system for emergency response, the Incident Command System (ICS). ICS is a function-based management system used in the United States and will be discussed in Chapter 5 - Management.

The Key Success Factors compares well with the Oil Spill Preparedness concept model in Figure 15. In this case b) would sort under the Prevention pillar, c) under the Planning pillar, d), e), f), and g) as Response pillar, and a) would correspond to the Management foundation.

2. UNEP Regional Seas

Moller et al. (2003) discuss preparedness in light of work done by the United Nations Environment Programme (UNEP) in 13 Regional Seas around the world. The factors impacting preparedness in this paper are:

a) The designation of a competent national authority to deal with marine emergencies.
b) The preparation and adoption of national contingency plans.
c) Participation in regional or multilateral spill response arrangements.
d) The provision of spill response equipment and materials.
e) The ratification of certain relevant international conventions.

These factors can all be compared with the Oil Spill Preparedness concept model, with a) corresponding to the Management foundation, b) to the Planning pillar, c) and e) to the Prevention pillar, and d) to the Response pillar.

3. Atlantic approach

Veiga (2004) divides her model for oil spill preparedness into four parameters,

a) Emergency towing arrangements.
b) Contingency planning practices.
c) Response performance in selected past spills.
d) Oil pollution legislation.

Each parameter is then qualitatively assessed and scored from a range of different indicators. These scores then sort the countries (United States, United Kingdom, France, and Spain) into three different categories. The categories are *low*, corresponding to initial application of standards; *medium*, corresponding to improving standards; and *high*, corresponding to desired standards for each country assessed.

These parameters also roughly compare to the concept model, in that b) would correspond to the Planning pillar, c) to the Response pillar, and d) to the Prevention pillar. In the model, a) is not considered part of the on shore response, as it takes place at sea, and thus is left out of the assessment.

In addition to work done specifically on oil spills, much research has been done on generic crisis and disaster management (Danielsson et al., 2012; Danielsson & Larsson, 2011; Hossain & Kuti, 2010; Ödlund, 2007; 2010; Perry, 2004; Perry & Lindell, 2003; Quarantelli, 1982; Tierney, 1993). Similarly to oil spill preparedness, research on crisis management started in the 1950s in the United States and focused on social behaviour (Tierney, 1993). However, the types of disasters in this context are primarily related to natural disasters such as earthquakes and hurricanes as well as technological disasters, such as nuclear disasters. The social science related to disaster management is focused on human behaviour in crisis situations, as discussed in Chapter 3. The terminology related to disaster management would therefore fit better with the dissertation definition of preparedness as a whole, rather than management.

In a comprehensive review paper on disaster management, Tierney (1993) described four distinct phases of disaster management. These phases are *mitigation*, *preparedness*, *response*, and *recovery*. *Mitigation* is defined as policies and actions taken before an event takes place and which are meant to minimise the damage of a disaster event, for example land use planning, design and engineering principles, and governmental policies. This *mitigation* corresponds well with the Prevention pillar and is defined similarly. *Preparedness* is defined as the *"second line of defence"*, for example with emergency plans, risk assessments, and training. As *preparedness* aims to enhance the ability to respond in case of a disaster, it corresponds to the Planning pillar. The exception is that training and exercises are considered part of the Response pillar and not the Planning pillar, due to the effects of training in enhancing response capacity. Only the planning of training and exercises is considered part of the Planning pillar in the model. Tierney's *response* actions are taken at the time of the disaster (or before if the disaster is predicted) and are intended to reduce the impacts, for example by evacuations, building emergency shelters, and communication with the public. This *Response* corresponds to the Response pillar, with the exception of training and exercises discussed above. Finally, Tierney defines *recovery* as long-term efforts to reconstruct and restore the impacted area, dealing with the disruption that the disaster has caused community life, and mitigating future hazards. The *recovery* phase is left out of the concept model because *recovery* is not considered part of the Response pillar in the concept model, but rather as the consequences of response and impact. The exception is the mitigation of future hazards, which is considered to belong to the Prevention pillar. Admittedly, oil spills may require years or even decades of recovery time, often in terms of environmental impacts, and legal implications and settlements (IOPC Funds, 2011; 2014). Additionally, disaster management generally discusses disasters with a much greater infrastructural impact, such as earthquakes and tsunamis, which require extensive human rebuilding. As such, *recovery* does not warrant an additional pillar in the concept model.

4.2.3.3 Refined model

Evaluating the Oil Spill Preparedness concept model in light of the frameworks mentioned above, the concept was further refined. As the integrated nature of these pillars became apparent during the model refinement, the model was reimagined with the pillars as overlapping circles representing different phases of oil spill preparedness (see Figure 16).

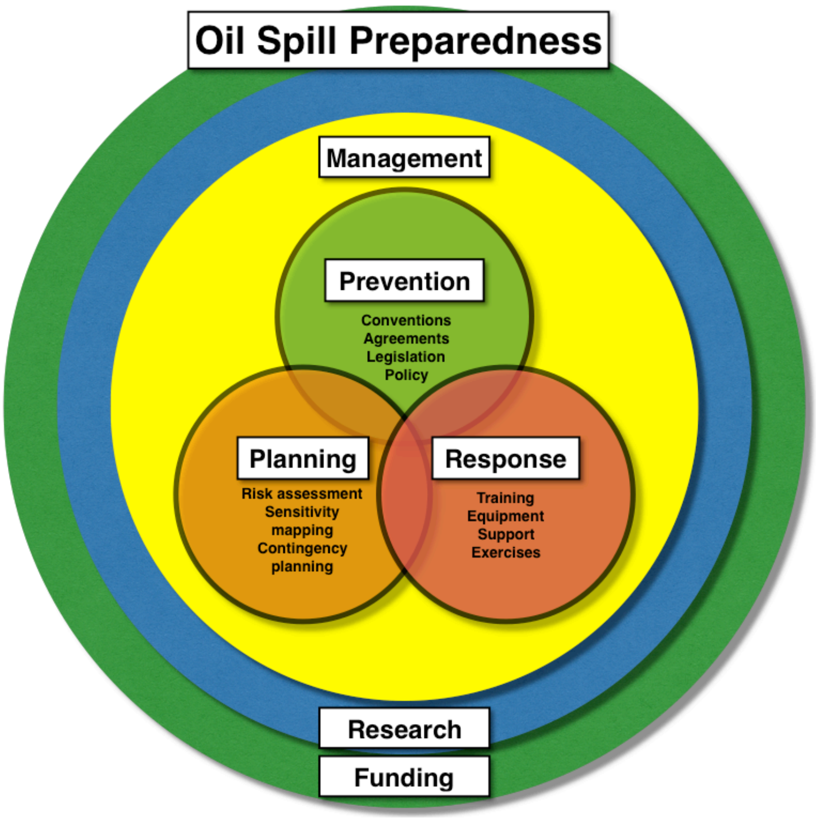

Figure 16: Refined Oil Spill Preparedness model.

An important observation is that the three central topics (Prevention, Planning, and Response) are reflected in most of the models reviewed, indicating that they are considered essential for the preparedness system to work. These central topics overlap and interact to a large degree. Many conventions, agreement, legislation, and policies regulate planning or response requirements. Much planning is based on requirements or recommendations from agreements or legislation and influences the response strategies and equipment need. Exercises and real spills in turn influence policy changes and contingency planning.

The additional topics from this refined Oil Spill Preparedness model are used in selection of units of analysis and variables. However, the foundational research and funding are not addressed in separate chapters, as they are embedded in the central prevention, planning, and response topics and analysed as part of them.

4.2.4 Hypotheses

One main hypothesis and five embedded hypotheses have been established to cover the research questions.

4.2.4.1 Main hypothesis

The overall research question for this dissertation on Swedish oil spill preparedness has been formulated in the main hypothesis:

Hmain – Sweden is prepared for an oil spill of 10,000 tonnes

Which gives the null hypothesis:

$Hmain_0$ – Sweden is not prepared for an oil spill of 10,000 tonnes

The main hypothesis is subdivided into five embedded hypotheses based on the refined Oil Spill Preparedness model in Figure 16. The Management foundation, Prevention, Planning, and Response topics, have their own hypotheses and subsequent units of analysis (see Figure 17). Additionally, in order to compare Swedish oil spill preparedness to other countries, the topic of International Practice has been added. The variables of the units of analysis for Hmain correspond to

Chapters 5 to 9 in this dissertation. In turn, Chapters 5 to 9 have their own variables, discussed in the respective section below.

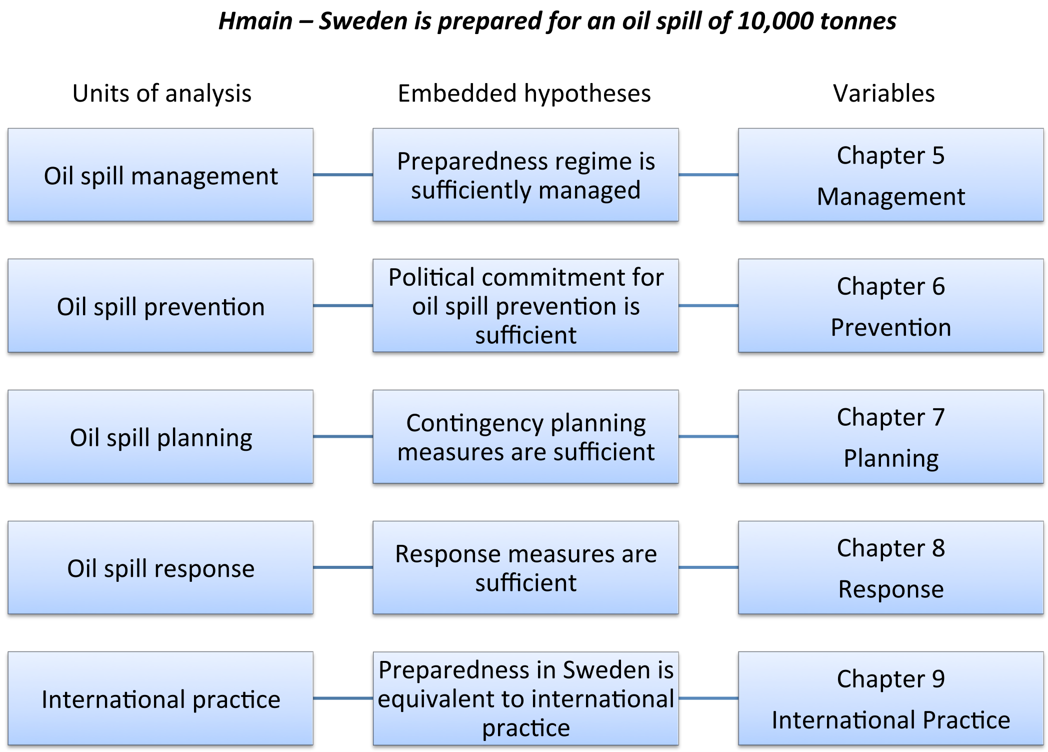

Figure 17: Main hypothesis chosen indicators, units of analysis, and variables.

A large oil spill is defined to be 10,000 tonnes of oil in this dissertation. This specific oil spill weight is mentioned in the oil spill manual from the Swedish Civil Contingency Agency (MSB) to the municipalities (Kulander et al., 2004). This manual states that the goal of Swedish onshore oil spill preparedness is to be prepared for oil spills where a single spill would be up to 10,000 tonnes by the year 2010. As this was the strategic aim between 2004 and 2010, 10,000 tonnes is a suitable definition. These 10,000 tonnes are tied to the responsibilities of the Swedish Coast Guard (SCG), who has an operational goal of being prepared to handle oil spills at sea, where a single spill would be up to 10,000 tonnes (Regeringen, 2007c). This goal was increased from 5,000 tonnes in 2005 (Regeringen, 2004b). However, the goal of 10,000 tonnes is absent from the updated Swedish Strategy for Oil Spill

Preparedness (NSO, 2014b), which replaced the MSB manual in 2014. No definition of time limits for the response is mentioned in either document, but is assumed to be within a reasonable amount of time, interpreted in this dissertation as a few years rather than decades. An oil spill of 10,000 tonnes would be classified as an *exceptional spill* according to the classes outlined by the BRISK project for the Baltic Sea (BRISK, 2011), as discussed in Chapter 2. However, compared to global data on previous oil spill accidents reaching well over 100,000 tonnes (ITOPF, 2014a), 10,000 tonnes would not be considered an exceptionally large spill on a global scale.

However, responding to oil spills is extremely weather dependent. During a storm, no vessels can operate and most of the equipment cannot be deployed or function, for example beach cloth and booms. Oil will also spread and emulsify faster and may become partially submerged, making detection difficult (Kingston, 2002). Other factors, such as daylight hours during winter and oil spill accessibility in remote areas will also play a role (Kingston, 2002; Singsaas & Lewis, 2011). In contrast, if the weather is calm, it is much easier to deploy the booms and skim oil, and evaporation will be much faster. Consequently, setting a figure such as 10,000 tonnes is indicative at best. It will be impossible to respond to 10,000 tonnes, or even 1,000 tonnes, in a storm, whereas the response capability in calm weather for the same resources is vastly improved. A realistic number is thus impossible to correctly determine, and is the main reason the number has disappeared from the Swedish Strategy for Oil Spill Preparedness (NSO, personal communication, September 2015). Therefore, 10,000 tonnes is used as an approximation by the response organisations and in this dissertation.

The term sufficient used in the hypotheses is defined as sufficient to accomplish the intended function of the hypotheses. Examining the variables can yield different results and three ranks of achievement were used: *Preferable*, *Sufficient*, and *Insufficient* (see Table 4).

Table 4: Achievement ranks for the variables.

Rank	Definition	Criteria
Preferable	The unit of analysis is at the best practice level.	Proof of function at the highest level. Score of 95% or more.
Sufficient	The unit of analysis is present and working, but should be further developed.	Proof of function as intended. Score from 50% up to 95%.
Insufficient	The unit of analysis is absent or not functioning.	Proof of not functioning. Score below 50%.

These levels correspond to if a variable is wholly present and/or functioning (*Preferable*), partially present and/or functioning (*Sufficient*), or not present and/or functioning at all (*Insufficient*). Variables that do not work or exist in even 50% of the cases are not considered to be functioning and ranked *Insufficient*. Variables that work roughly as intended or exist in 50% up to (but not including) 95% of the cases are considered to function and ranked *Sufficient*. Variables that work or exist in 95% up to 100% of the cases are considered to function at the best practice level and are ranked *Preferable*, corresponding to the ideal situation. The rationale is that some variation can be accepted, as long as the majority is functioning at the highest level. Although statistical mathematics would not be suitable in analysis of most of these variables, 5% is chosen as an acceptable level of deviation from a full score. These 5% corresponds to the two standard deviations covering 95% of the values in a normal distribution. This 95% limit is the basis for measuring significance in statistical tests and is thus judged to be a suitable approximation for the analyses.

These three levels have been used to rank all of the variables in the embedded hypotheses. However, slight variation from the percentages have sometimes been utilised for individual variables and explained in the respective chapter. Following the reasoning above, all of the variables are interlinked and must perform sufficiently. Thus, no variable can be ranked *Insufficient* for the hypotheses to be accepted. Consequently, all of their variables must be ranked *Sufficient* or *Preferable* for any of the embedded hypotheses to be accepted.

The results in Chapters 5 to 9 have their own embedded hypotheses, H1 to H5, to relate to. These are combined to assess the main hypothesis, Hmain. Logically, rejecting all of the embedded null hypotheses, $H1_0$ to $H5_0$, means that the main null hypothesis, $Hmain_0$, is also rejected. Correspondingly, accepting H1 to H5 means that Hmain is also accepted. But what about other combinations of acceptances and rejections for H1 to H5 and $H1_0$ to $H5_0$? Looking back at the refined Oil Spill Preparedness model (see Figure 16), the argumentation supports the notion that the prevention, planning, and response topics must function for oil spill preparedness to work sufficiently. Management must also function and is thus considered separately in Chapter 5, while the research and funding are examined embedded in Chapters 6 to 8. Sweden should also have oil spill preparedness equivalent to international practice, as discussed in Chapter 9. Thus, $H1_0$ to $H5_0$ must all be rejected for Hmain to be accepted.

Similarly, H1 to H5 face the same problem as Hmain. Using the same reasoning as above, all of the units of analysis will have to demonstrate that they are sufficient for any of H1 to H5 to be accepted. This means that the requirements to fulfil Hmain are high, because if even one of the variables is ranked *Inadequate* in any of H1 to H5, Hmain will be rejected. This sensitivity to specific variables may not fully reflect the nuanced status of oil spill preparedness in Sweden. As such, the hypothesis testing should be viewed as comparing to a utopia, where all parts of the preparedness exist and function flawlessly. This situation is what accepting Hmain represents. This utopia is unachievable, but something to strive for and the real response will be highly dependent on the conditions during the oil spill itself. It is also interesting to analyse how close Sweden is to this utopia and examining the units of analysis and corresponding variables will achieve this.

4.2.4.2 Hypothesis 1

The first embedded hypothesis relates to how Swedish oil spill preparedness is organised and managed and is formulated as:

H1 – Preparedness regime is sufficiently managed

Which gives the null hypothesis:

$H1_0$ – Preparedness regime is not sufficiently managed

Hypothesis 1 is chosen to analyse issues related to the organisation of Swedish oil spill preparedness: its structure and its division of responsibilities. This reflects how logical the management structure and the division of responsibility are, which will have an impact on how the command structure is understood by the organisations involved. Connections between the involved organisations, clear roles, and structures for interaction and communication need to be established and exercised before an oil spill.

This is operationalised into: if the expected structure follows the organisational responsibilities, how the organisations are connected, if the structure is understood by those involved, if the organisations are valued, and if the structure follows the expectations of the organisations (see Figure 18). Hypothesis 1 is tested in Chapter 5.

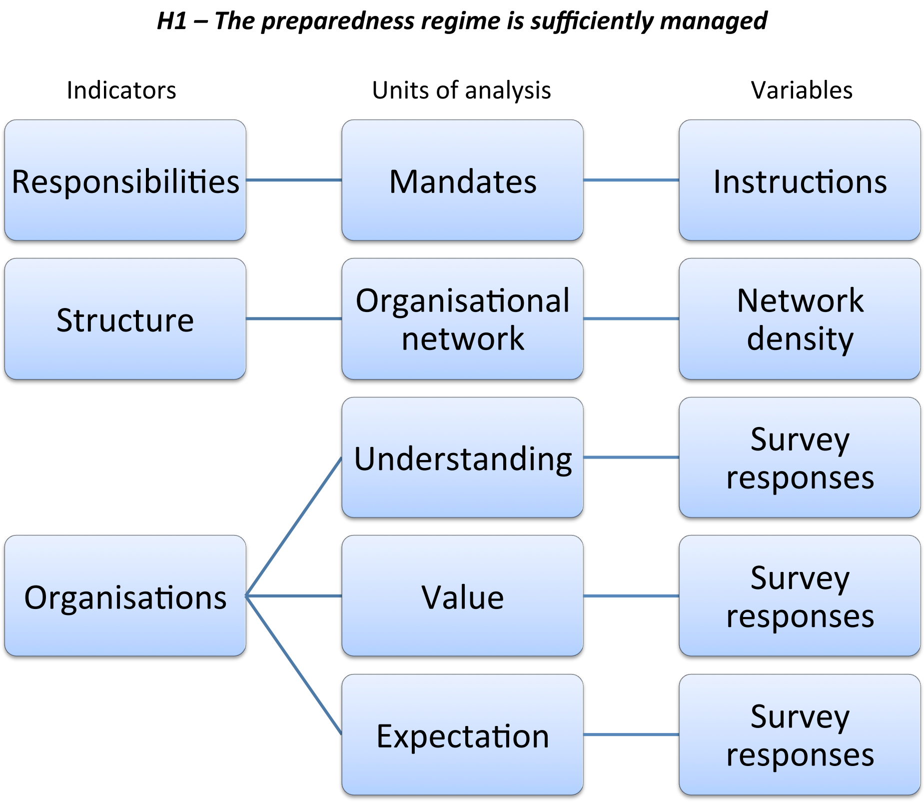

Figure 18: Hypothesis 1 chosen indicators, units of analysis, and variables.

As has been identified in some of the exercise evaluations (Ljungkvist et al., 2013; MSB, 2012) and project reports (Baltic Master, 2006), the division of responsibility among the involved organisations is not always clear and this was reflected in the chosen units of analysis.

If Swedish oil spill preparedness is effectively managed, the organisational structure follows a path tied to the organisational responsibilities. The two main agencies on land and sea, MSB and SCG, should have connections to all coastal municipalities and County Administrative Boards (CABs). Municipalities should be connected to their neighbours and their respective CABs. The involved organisations should be well aware of the other organisations' mandates and responsibilities and these responsibilities should follow the expectations. In short, all organisations involved should have a clear understanding of their own and other organisations' place and responsibilities in the system.

This structure is partly a communication and exercise problem, as structure and responsibilities may be unknown outside the organisation. However, no organisation can or will act alone if a large oil spill occurs. Knowledge of other involved organisations is essential for any complex operation, such as an oil spill. Therefore, it is the responsibility of all organisations that have a role in oil spill response to have established such connections and gathered the necessary knowledge.

4.2.4.3 Hypothesis 2

The second embedded hypothesis relates to the Swedish political commitment to, and implementation of, the international legislation related to oil spills, and is formulated as:

H2 – Political commitment is sufficient

Which gives the null hypothesis:

$H2_0$ – Political commitment is insufficient

Hypothesis 2 is chosen to analyse a major indictor of whether oil spill prevention is sufficient: political commitment. This is reflected by how international legislation is implemented by the Swedish government. Firstly, the government has a role in signing the conventions and agreements; secondly, it needs to designate a responsible organisation to oversee the convention and agreement implementation; thirdly, it needs to budget sufficient funds for the responsible organisations to be able to perform their assigned responsibilities.

This is operationalised into: which international conventions are ratified and how they are implemented, which international agreements are signed and how they are implemented, and what the organisational budgets are for enforcing these conventions and agreements (see Figure 19). H2 is tested in Chapter 6.

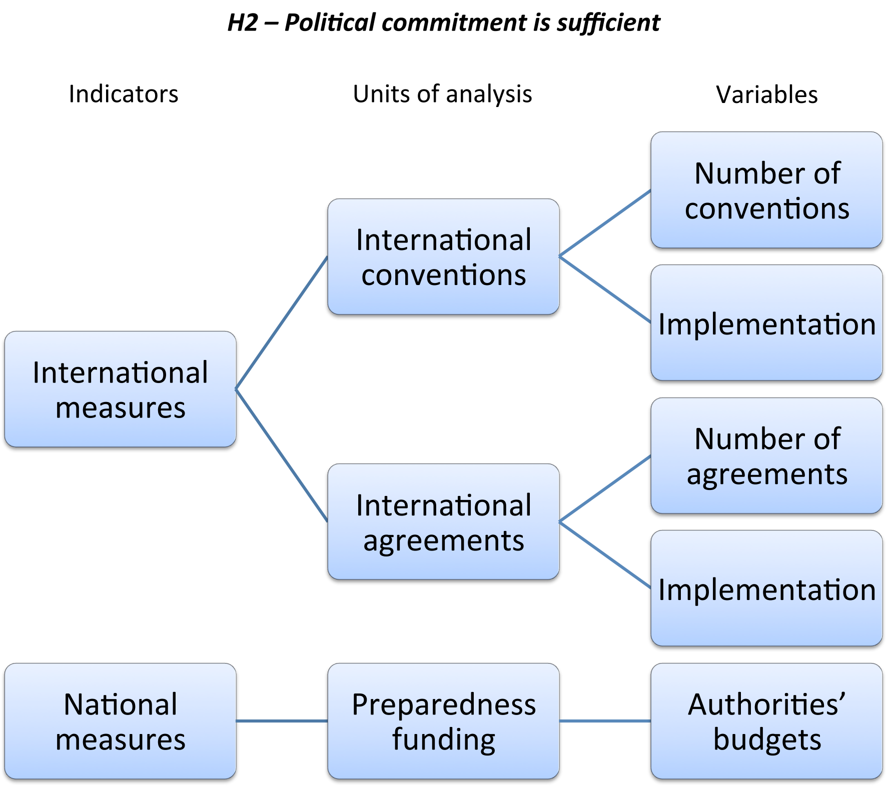

Figure 19: Hypothesis 2 chosen indicator, units of analysis, and variables.

As the literature review revealed criticism against the level of implementation and enforcement of some of these conventions (Hassler, 2008; 2010; Knudsen & Hassler, 2011), the ratification of international conventions relating to oil spill preparedness and their implementation were chosen as the units of analysis.

There are several international conventions and agreements relating to oil spill preparedness and response. The political commitment can be measured by how many conventions have been ratified or agreements signed. Ratifying a convention or signing an agreement signals intent, but do not involve as much effort as implementation. It is therefore reasonable to assume that all relevant international conventions and agreements should be signed, if any political support exists. Implementation is analysed by examining if Sweden has fulfilled the obligations described in the convention and agreement texts. This is harder to evaluate, as the texts are often open to interpretation or does not specify to which extent a measure should be implemented. Implementation analysis consequently becomes more subjective, but is guided by the specifications and intentions of the texts as much as possible. Finally, annual budgets and budget instructions correspond to the political priorities for the fiscal year. The agencies should ideally receive sufficient budget to perform their assigned responsibilities. However, priorities within organisations will make the real effect of the budget hard to analyse. A comparison will therefore have to be made with previous budgets, to see the general trend.

For oil spill preparedness to be considered to have political commitment, the relevant international conventions should be ratified and agreements signed, should be implemented, and the responsible organisations sufficiently budgeted. H2 excludes the inherent values of the different conventions, as this topic would be better suited for a complementary PhD.

4.2.4.4 Hypothesis 3

The third embedded hypothesis relates to the Swedish system for, and status of, oil spill contingency planning, and is formulated as:

H3 – Contingency planning measures are sufficient

Which gives the null hypothesis:

$H3_0$ – Contingency planning measures are insufficient

Hypothesis 3 is chosen in order to analyse several major issues indicating if oil spill planning measures are sufficient: the priority of oil spill contingency planning in organisations, risk awareness, available resources, and participation in external projects. In order to write a good contingency plan, there is a need to have a risk assessment for oil spills, know the coastal environmental sensitivity, as well as prioritising areas for protection. The commitment of an organisation is reflected in the resources designated for a task. Being open to external advice and taking part in collaboration projects also reflects the organisations' commitments to oil spill planning.

This is operationalised into: the existence of risk assessments, sensitivity maps and contingency plans, available staff resources and budget, and participation in external projects (see Figure 20). H3 is tested in Chapter 7.

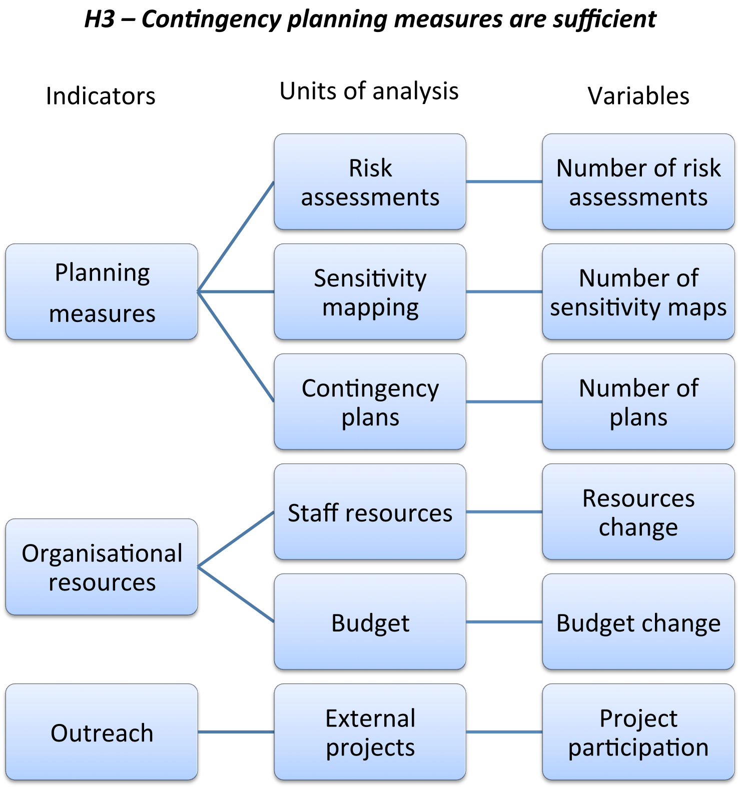

Figure 20: Hypothesis 3 chosen indicators, units of analysis, and variables.

Since the planning process itself consists of many different aspects, the units of analysis focussed on evidence concerning different parts of the planning process by the organisations. The analysis of the content of the plan itself has been excluded, as supported by Perry and Lindell (2003) regarding the importance of the planning process itself, rather than the finished document.

To make the best priorities during oil spill contingency planning, a risk assessment must exist, either a local one or a regional one detailing the oil spill risk in the area (API, 2013c; IPIECAOGP, 2015; ITOPF, 2011b). Additionally, good knowledge about the sensitivity of the coast should exist in the form of a sensitivity map. This map should be easily distributed and used to get an overview for both planning and response purposes. How useful a plan is depends on what the plan covers and whether the affected organisations have exercised the plan accordingly. However, having a recently revised plan is the end result of the first step of the planning cycle, which will continue by exercising the plan and revising it. Having a plan or not is an indicator as to whether an organisation is working with oil spill preparedness. Similarly, the resources dedicated to oil spill preparedness also indicates how prioritised the issue is. However, resources spent may be periodical, with a higher workload surrounding the planning, execution, and reporting of a larger exercise, for example. This makes the role of the resources harder to interpret if taken out of context. If resources are increased, but no risk assessment, sensitivity map or plan is produced, the question of how the resources are spent will arise. Reversed, a reduction of available resources coupled with increased productivity suggests that the issue has been successfully internalised into the organisation, but may also warn that the issue is not being prioritised. External participation in projects has many advantages, for example extra resources available, an externally driven time plan to follow, and external help. Therefore, project participation is also a good indicator of commitment.

For Sweden to have sufficient oil spill contingency planning measures, relevant organisations should have an updated oil spill contingency plan, based on a risk assessment and taking into account the sensitive areas, and continuously exercise and revise the plan. However, it could also be argued that measures are sufficient if a positive trend can be shown and an increasing number of organisations are writing and revising their contingency plans.

4.2.4.5 Hypothesis 4

The fourth embedded hypothesis relates to the Swedish system for oil spill response and exercises and is formulated as:

H4 – Response measures are sufficient

Which gives the null hypothesis:

$H4_0$ – Response measures are insufficient

Hypothesis 4 is chosen in order to analyse factors indicating whether oil spill response measures have sufficient equipment, training, exercises, and works systematically with known issues discovered during real spills and exercises. This reflects organisational and system knowledge, and learning among the organisations responsible for the oil spill response. The response itself needs management and plans to be effective, but the responder needs two basic things to be effective: training and equipment. Sweden has regional depots of oil spill equipment located around the country. Annual national training courses are organised by the Swedish Civil Contingencies Agency (MSB). The responsibility to conduct exercises is left to the regional and local authorities, meaning the County Administrative Boards (CABs) and the municipalities. Exercises serve two primary functions; they raise awareness among the participants and evaluations show topics in need of improvement.

This is operationalised into: participation in and quality of training, equipment location and amount, exercises participated in, lessons learned from exercises and real spills, and external project participation (see Figure 21). H4 is tested in Chapter 8.

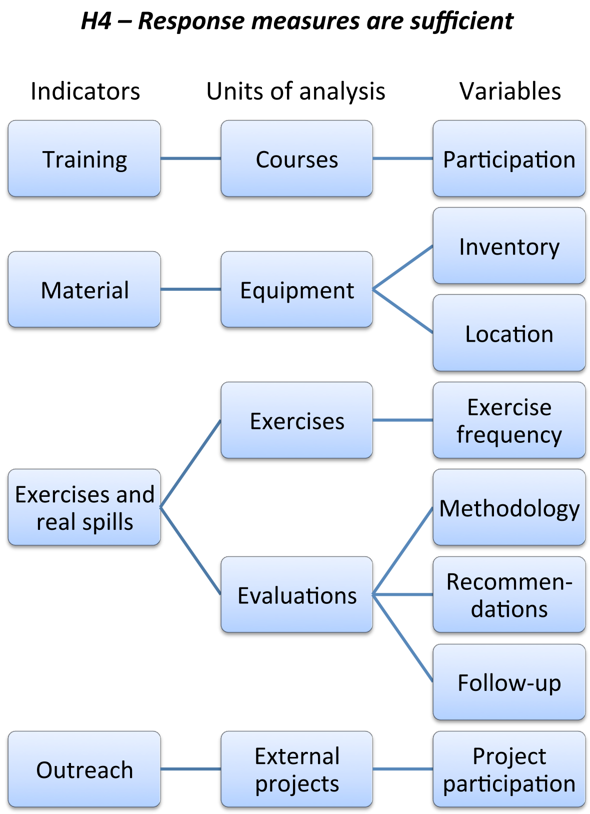

Figure 21: Hypothesis 4 chosen indicators, units of analysis, and variables.

While there are regular exercises at sea in Sweden, the few exercises onshore and the few real spills have shown that there are issues to be addressed in the Swedish oil spill response (MSB, 2012; MSBHaV, 2014). These are the focus of the chosen units of analysis.

Training courses are excellent indicators as they can determine the number of trained personnel. At least one person in each organisation should be specialised in oil spill by having participated in one of the courses. However, no analysis of the course quality is included in the analysis, only factors related to quality control. The regional Oil Spill Depots should be strategically located to minimise deployment time to high risk and/or especially vulnerable areas and have sufficient equipment to handle the designated amount of oil. Exercises are vital to testing the planned response and should be conducted frequently (Cashman et al., 2003; Perry & Lindell, 2003). In order to improve, exercises need to be evaluated and the recommendations followed up.

Sweden would be considered to have sufficient response measures if there is evidence that personnel is properly trained, sufficient equipment exist, and there is a structured approach to working with identified oil spill response issues.

4.2.4.6 Hypothesis 5

The fifth hypothesis relates to how Swedish oil spill preparedness compares to other nations and is formulated as:

H5 – Preparedness in Sweden is equivalent to international practice

Which gives the null hypothesis:

$H5_0$ – Preparedness in Sweden is not equivalent to international practice

Hypothesis 5 is chosen in order to compare the level of Swedish oil spill preparedness to neighbouring countries. The number of international conventions ratified is one suitable indicator. However, it does not reveal any information on the implementation of these conventions, which is likely to differ significantly (Knudsen & Hassler, 2011). The strategic target values for responding to oil spills differs between countries and reflects the ambition of the oil spill response, as this target should be supported with the corresponding resources. It is also interesting to examine as an indicator of international practice, as no standard exists. There is no international guide for contingency planning and exercises, but the oil and gas industry have developed several measures, for example contingency planning templates and guides (API, 2013c; IPIECAOGP, 2015; ITOPF, 2011b). These standards could be considered to be the industry best practice, as most companies use them. A useful tool that has been developed is the RETOS™ standardised preparedness evaluation (Taylor et al., 2014; Taylor & Lamarche, 2014), which is used to compare Sweden to neighbouring countries.

This is operationalised into: the number of international agreements and targets, use of National Contingency Plans and the Tiered Preparedness and Response concepts, and the score of the RETOS™ evaluation tool (see Figure 22). H5 is tested in Chapter 9.

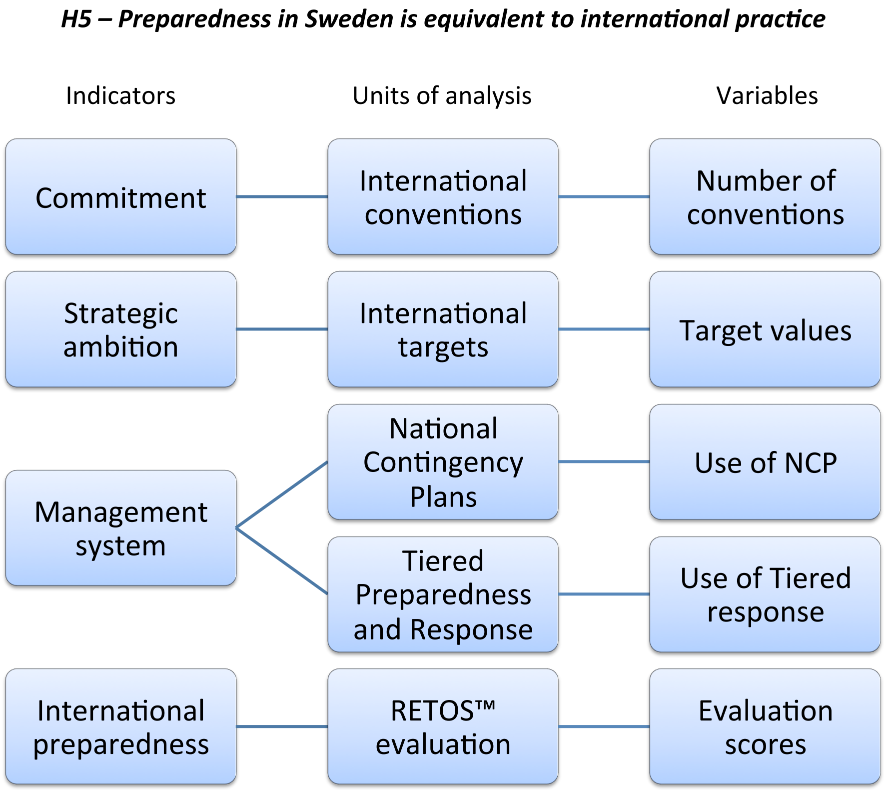

Figure 22: Hypothesis 5 chosen indicators, units of analysis, and variables.

A large oil spill could potentially impact several nations. With Sweden's exposed location and long coastline, the nation would greatly benefit from being proactive when it comes to oil spill preparedness in an international context, as pointed out by several authors (Hassler, 2008; Pålsson et al., 2012). This includes taking part in international cooperation and adhering to international best practices. This reasoning prompted the choice of the units of analysis for H5.

For Sweden to be considered to have oil spill preparedness equal to international practice, Sweden should follow the international practices and have strategic targets and a RETOS™ evaluation score equal to the neighbouring countries. It is outside the scope of this thesis to go into depth on oil spill preparedness in all of the countries of the world, so the focus is on the neighbouring countries.

4.2.5 Validity

Validity concerns the accuracy of the results and can be further subdivided. Important types of validity for this study are discussed below.

4.2.5.1 Construct validity

Construct validity concerns identifying and operationalising the correct measures for the concepts of the study. This is increased by using triangulation, suggested by Yin (2014) and Trochim (2006) and discussed previously. By choosing the specific concepts elaborated in the Oil Spill Preparedness model and operationalising them, a robust and triangulated chain of evidence has been provided. This approach examines the issue of oil spill preparedness using several different approaches to analyse a broader spectrum of influencing factors. Since no publications could be found that matched the operational measures to concepts, deductive reasoning was used for the conversion of indicators to units of analysis. For example, if possible, the information from the questionnaire was corroborated with document sources and vice versa, in order to increase construct validity.

4.2.5.2 Internal validity

Internal validity addresses the causal relationship between two events, and if and how one event caused the other (Trochim, 2006; Yin, 2014). This is controlled by using pattern matching for similar events and using deductive reasoning to establish rival explanations to be falsified. These rival explanations are represented in the indicators in the hypotheses section.

4.2.5.3 External validity

External validity concerns how and to what extent the findings of the study can be generalised to other locations or settings (Trochim, 2006; Yin, 2014). This is primarily discussed in Chapters 9 and 10, which examines the dissertation results in comparison to oil spill preparedness in other countries.

4.2.6 Reliability

Reliability concerns the consistency of measurements and the need for the findings to be repeatable by other scientists (Trochim, 2006; Yin, 2014). This is primarily addressed through maintaining a rigorous case study protocol and database. The problem with case studies is that they are often based on a contemporary case where the scientist will not have complete control over all surrounding factors. It may be difficult, if not impossible, to replicate the exact context at another time. The most important factor for reliability in this situation is to properly document the research procedures and raw data (Yin, 2014), which has been done in this study. This will make it possible for other researchers to be able to use the same data and analyse it themselves using different methods, ideally agreeing with the conclusions of this dissertation.

4.3 Research ethics

The World Maritime University (WMU) Research Ethics panel approved this study as seen in the *Compliance with Guidelines on Good Research Practice* section in the Preface.

The survey used in this dissertation for the questionnaire and the interviews was submitted in Swedish and English to the WMU Ethics Committee 3 December 2014 (see Appendix A - Questionnaire and Appendix B - Interview). It was approved 15 December 2014, before distributing the questionnaire part of the survey to the respondents and using the full survey during interviews.

The respondents to the questionnaire were contacted in their role as public employees working at government authorities (see Appendix C - Sendlist). Since they are civil servants with listed professional email addresses, no intrusions into the respondents' privacy were made. Each respondent additionally approved the terms and conditions of the survey, which was set out on the first page of the questionnaire (see Appendix A - Questionnaire).

The informants from the interviews, like the respondents to the questionnaire, were assured that their responses would be made anonymous before use in this dissertation and in publications. Before the interview started, the informants accepted the same terms and conditions as the questionnaire respondents and all informants signed a Letter of Consent (see Appendix D - Letters of Consent).

4.4 Limitations

There are several limitations to and assumptions about the research approach that need to be stressed.

4.4.1 Surveys

When dealing with surveys using a questionnaire, there are issues with reaching the target audience, having them read through, consider, and interpret the questions correctly, and not fatiguing the respondents by creating a lengthy survey (de Vaus, 2014). These factors were considered during the process of designing and refining the questions, and during the pilot study discussed in section 4.5.2.1 Pilot. The online survey tool used, SurveyGizmo, automatically logs various respondent statistics, for example the time it took to go through the questions and if any of the open-ended responses seem false based on automated word analysis. This gives an indication of the quality of the responses. However, the survey does not reveal any information on the level of oil spill preparedness for those that did not respond. A logical assumption would be that respondents that chose not to answer the questionnaire have a lower than average preparedness as they evidently do not prioritise the issue.

This was exemplified by the fact that some potential respondents opted out of the survey and one person sent an email declaring that participation was not a priority.

Likewise, there are inherent issues in performing interviews related to how questions are asked, how they are interpreted, and how truthful the informants are (de Vaus, 2014; Gummesson, 2000; Trochim, 2006). Having only a single interviewer perform all of the interviews with mostly familiar contacts was intended to control these effects. This familiarity was intended to create an environment of trust, where the respondents felt secure enough to answer truthfully and without bias towards what they thought the interviewer would like to hear.

4.4.2 Data access

Data that are unpublished or inaccessible to the public could be very informative, but difficult to access. Organisations may have collected data that is hidden away, for example in an internal report, memo, or repository. Most probably, the researcher is not even aware of the existence of such data. This is especially true of older printed sources that may only exist in a few physical locations. This is mitigated during the knowledge-gathering phase, which reduces the likelihood of missing valuable datasets with increased subject knowledge and simultaneously increases data access through network contacts.

4.4.3 Language access

Language access is similar to data access and a language barrier restricts the access to both finding texts and to understanding them. This could be a data collection weakness, since an unknown amount of research has been done on oil spill preparedness in the former member states of the Soviet Union. However, using modern translation tools and translators mitigates this effect. Additional effort has been made to find relevant references through the Russian librarian at WMU, and through the oil spill preparedness network in the Baltic Sea Region. Thus, it is unlikely that any major source of data have been missed.

4.4.4 Time constraint

As always, time constraints must be considered. The cut-off point for data collection should ideally be when additional data do not change the evidence or covers the topic completely. In reality, there is a subjective point where the researcher judges that no more relevant data will be found. Considering the access issues above, this may or may not be the right decision to make. This issue has been controlled by proper pre-understanding of the topic, as recommended by Gummesson (2000).

4.4.5 Organisational changes

During the course of the survey, the contract for the Oil Spill Advisory Service (OSAS) at the consultancy company Sweco expired, and many of the contact persons in the municipalities and CABs switched position within and between organisations or retired. This was controlled for as much as possible by administering the questionnaire before the change. However, a few municipalities did not respond to the questionnaire because they did not, at the time, have anyone responsible for oil spill preparedness.

4.5 Methods

Different research methods have been used in this dissertation, almost exclusively from the field of social science.

4.5.1 Literature analysis

The principal research method that was used was literature analysis by examining available discourse.

4.5.2 Survey

The semi-structured survey questions were formulated in English according to established guidelines (de Vaus, 2014) and translated to Swedish. The survey was divided into two parts: a questionnaire with a majority of Likert item multiple-choice questions (see Appendix A - Questionnaire) and a shorter interview with statements and Likert item multiple-choice, and open ended questions (see Appendix B -

Interview). The Likert item options followed established standard formulations (RP Group, 2003). Both questionnaire and interview questions were asked during the interviews.

The *"no opinion"* option was omitted from many questions of the survey because it targeted professionals with a working knowledge on the subject. The neutral option of the Likert items was left intact for those that did not have strong opinions either way.

4.5.2.1 Pilot study

Following literature recommendations (de Vaus, 2014; van Teijlingen & Hundley, 2001), a pilot study was conducted during November 2014, after building the survey and refining it following tests on colleagues and professional contacts. The pilot study was performed on contacts that had until recently been working with oil spill preparedness issues in the survey target organisations (municipalities, CABs, and agencies), but did not currently hold such a position. In order to be able to maximise the number of responses, this was judged to be as close as possible to the real respondents, without diminishing the pool of actual respondents. The pilot study helped to develop the lines of reasoning, to refine the questions, subtract some questions, and add new questions that reinforced the evidence for specific hypotheses.

4.5.2.2 Questionnaire

All of the regional and local governments with a coastline towards Swedish state water, defined in Swedish law as the Baltic Sea, the North Sea, and the three largest lakes: Vänern, Vättern, and Mälaren (de Vaus, 2014; van Teijlingen & Hundley, 2001), were selected for the questionnaire respondent groups. This corresponds to 126 coastal municipalities and 18 coastal CABs (see Appendix C - Sendlist) and represented two populations; municipalities and CABs. The foundation for the contact points was a mailing list used for a previous survey (Pålsson & Wåhlander, 2013), combined with multiple participation lists acquired from numerous oil spill conferences and events during the course of the research.

4.5.2.3 Interview

Swedish national oil spill experts were selected to be the interview informants. These were defined as the members of the National Cooperation Group for Oil Combating (NSO). NSO consists of representatives from the Swedish Coast Guard (SCG), the Swedish Civil Contingencies Agency (MSB), the Swedish Agency for Marine and Water Management (SwAM), the Oil Spill Advisory Service (OSAS) at Sweco, the Swedish Maritime Administration (SMA), the Swedish Transport Agency (STA), the County Administrative Boards (CABs) and the Swedish Association of Local Authorities and Regions (SALAR). Representation from the Environmental Protection Agency (EPA) was replaced by SwAM after this agency's creation in 2011, but EPA is again part of the NSO since fall 2015. The interviews excluded the representatives of the municipalities (SALAR) and the CABs, because these provided more detailed input through the questionnaire from each individual municipality and CAB. NSO meets twice a year to discuss recent oil spill events and continuously works on oil spill related projects, either together or through its respective organisations. During 2014, NSO finalised the Swedish Strategy for Oil Spill Preparedness (NSO, 2014b) and during 2015, an associated Action Plan has been developed and circulated for comments. Close collaboration was established with most of the members of this group during the oil spill projects worked on during the study. Thus, it was easy to approach NSO and convince them to be informants for the interviews. This was also a deliberate strategy to minimise bias in the form of withheld opinions, as the informants were counted on to trust the confidentiality and answer truthfully.

4.6 Data collection

There are different sources available on the topic of oil spill preparedness, but much of this has not been published in academic journals. Data from the survey questionnaire and interviews complemented data from literature sources.

4.6.1 Literature sources

Literature has been gathered from a wide variety of publicly available sources. Scientific papers have been gathered through the library at WMU and open access journals and conference proceedings online. Official documents such as conventions, strategies, and statements have been collected from government agencies, authorities, and organisation webpages. Project reports have been gathered from the project pages of the Baltic Sea oil spill projects Baltic Master, Baltic Master II, BRISK, EnSaCo, MIMIC, and OILRISK.

4.6.2 Questionnaire

Respondents were approached through their official email addresses in November and December 2014, and in January 2015, and asked whether they or someone else in their organisation were responsible for coordination of oil spill preparedness. Representatives from each of the 18 CABs confirmed that they were the contact points, as did 124 of the 126 municipalities contacted. The potential bias for only reaching respondents with access to Internet and a computer when using an online survey was dismissed, since all of the respondents have publicly listed emails and computers with Internet access through their employers. As civil servants, they have an obligation to answer public inquiries. However, in reality, there is no requirement for them to do so, and they may feel that answering a questionnaire is not a priority. Voluntary participation in the survey was explicit in the instructions.

In total, there were 75 unique responses to the questionnaire. Of these, CABs represented 16 responses, corresponding to 89% of the selected group of 18 coastal CABs. From the municipalities, there were 59 responses, corresponding to 77% of the selected group of municipalities. Since many of the municipalities have joined their rescue services into various formations of rescue associations covering 2 to 10 municipalities, the questionnaire was sent to 77 unique email addresses, representing the 126 municipalities selected. The responses were completed to varying degrees from 0% to 100%, which is reflected in the survey results.

4.6.3 Interviews

Six separate interviews were conducted in the offices of the different organisations in January 2015 by the same interviewer. One member of NSO was on leave of absence without stable Internet access or telephone connection. It was decided to send the survey questions via email to this informant. These seven interviews correspond to all of the chosen informants. Following suggestions from Trochim (2006), none of the interviews were recorded, in order to ensure confidentiality and thus increase honesty. The equipment used was a pen, a notebook and a tablet computer, which had the survey questions online. Following the recommendations by Trochim (2006) and de Vaus (2014), the informants were allowed to talk uninterrupted between questions in each interview. When different answer options were available, the alternatives were shown to the informant after the question was asked, to facilitate memory of the alternatives and phrasing of the question. If anything was unclear, the notes were read back to the informant to confirm or deny the statements, and appropriate changes were made to the responses. The interviews lasted between one and two hours and were completed without interruptions. The informants gave an honest impression and took the questions seriously, evidenced by the observation that they often thought for some time before giving an answer. It may also have helped that the aim of the interview was research, and not to produce information for any specific government agency or evaluation. In this way, possible territorial bias and agency competition were controlled. Following each interview, the notes were revisited in the evening of the same day and rewritten into clearer sentences. This was a precaution to make sure that the notes would be understood later and information would be sensible, with the interview fresh in memory.

4.7 Analysis

Several analytical methods were used and are explained in the following section.

4.7.1 Coding

Coding means converting answers to numbers and then classifying them (de Vaus, 2014). This was done for the scaled survey responses in order to use them in statistical software. “*Yes”* and “*No”* answers were simply coded as dummy variables of 1 and 0 respectively and Likert item answers were coded from 1 to 5, with 5 being the most positive or affirming answer. Coding was done using the software search-and-replace function, in order to eliminate transcription errors.

4.7.2 Statistics

Survey data analysis was made using standard statistical approaches described by Trochim (2006), de Vaus (2014), and Yin (2014). These statistics describe the predominant answers and the variance and distribution, and tests dependencies between factors mathematically.

The statistical analysis and graphs were made using the GraphPad Prism version 6.0f statistical software. GraphPad Prism is a commercial programme by GraphPad Software. It is an intuitive programme with helpful documentation, which produces easily customisable graphs. This made it the most suitable software to use among the available competitors.

4.7.2.1 ANOVA

A two way Analysis Of Variance (ANOVA) is used when there is one measurement variable and two nominal variables (Fisher, 1925; McDonald, 2014). Each nominal variable must also be found in combination with each of the other nominal variables, which was satisfied in the dataset. ANOVA tests three hypotheses: if the means of the measurement variable are equal for different values of the first nominal variable, if the means are equal for different values of the second nominal variable, and that there is no interaction, meaning effects of one nominal variable do not depend on the value of the other nominal variable (McDonald, 2014).

4.7.2.2 Berger's test

For correlation tests between two binomial variables from the questionnaire, Berger's test has been used (Berger, 1996). Berger's test is an exact, unconditional test of homogeneity, meaning that it exactly calculates the probability of getting the observed data. It is more powerful than the originally intended Fisher's exact test for 2 x 2 tables (Fisher, 1925), which has a number of conditions limiting its power (Mehta & Senchaudhuri, 2003).

4.7.2.3 Dunn's post test

Dunn's post test is performed after Friedman's test. It calculates the expected average difference in the rank sum between two columns and compares it with the real value (GraphPad Software, 2015). The *p* value then takes into account the number of comparisons and is calculated for each pair of columns, identifying which pairs of columns are different form the rest.

4.7.2.4 Friedman's test

Friedman's test is a non-parametric statistical test that compares three or more matched or paired groups by ranking each row separately (GraphPad Software, 2015). The ranks in each column are then summed. The value of the Friedman statistic is then calculated from the sums of ranks and the sample sizes. If the *p* value is small, the differences between columns are not random, and at least one of the columns differs from the rest. A post test (usually Dunn's post test) is needed to see which columns differ from which other columns.

4.7.2.5 X^2

The X^2, or chi-square, test is used when there are two nominal variables and it is required to see whether the proportions of one variable are different for different values of the other variable. This is done by calculating the expected frequencies between the variables and comparing them to the observed frequencies (de Vaus, 2014; McDonald, 2014).

4.7.3 Evaluation analysis

Evaluation theory and aims have been discussed by several authors, although with a focus on a single organisation or programme (Hanberger, 2011; Saunders, 2012; Weiss, 1998). Different uses of evaluations exist, categorised by Saunders (2012) as instrumental, conceptual, enlightenment, process use, and persuasive or symbolic. The evaluation analysis identifies the intended use and the aims of the exercises and real responses, according to the framework criteria of usability practices in evaluation design, outlined in Saunders (2012). Additionally, how the recommendations will be followed up was analysed. This analysis described the use of the evaluations and real spills, and examines how the lessons learned have been utilised.

4.7.4 Network analysis

The novel methodological approach of this dissertation concerns the methods applied to assessing the organisational network for oil spill preparedness. As discussed in Chapter 3, this approach has not been found for oil spill preparedness in Sweden. Network theory has some unique characteristics, which means that the analysis must be handled differently from normal statistics (Newman, 2003). For example, real world networks are not random when it comes to the number of contacts, called degrees in network theory. Degrees do not have a traditional normal distribution, but are often highly skewed, meaning that they have a long tail of values that are far above the mean (Newman, 2003; 2008). These high-degree nodes or hubs represented by the tail can have a substantial effect on the behaviour of a networked system. The goal of studying networks is to understand and explain the workings of systems built on these networks, in this case Swedish oil spill preparedness.

Analysis related to network theory has been performed using the Gephi programme version 0.8.2 beta (Bastian, Heymann, & Jacomy, 2009). Gephi is open-source software for graph and network analysis by the Gephi Consortium. It uses a 3D render engine to display large networks in real time and can perform a variety of spatialising, filtering, and manipulating tasks. It is an intuitive programme with helpful documentation that produces graphs that are easy to customise, making it the most suitable software to use among the available competitors at the time.

4.7.4.1 Centrality measures

These types of statistics describe the basic attributes of a network and are most often the average network density, degree centrality and eigenvector centrality.

- Average network density is the ratio of the number of connections (called edges in network theory) per node (called vertexes) to the number of possible connections. This represents to what extent all organisations are connected to the others.

- Degree centrality, or degree of a node, is simply the number of connections. This represents to what extent an organisation is connected to others.

- Eigenvector centrality takes into account the quality of the nodes by examining how many connections each connected node has. Thus, an organisation with a smaller number of high quality contacts may outrank an organisation with a larger number of mediocre contacts. This assumes that influence is correlated with connections (Newman, 2008).

This analyses the attributes of the oil spill preparedness network in Sweden, based on connections and describes the links mathematically. It is used to improve the validity of the analysis, by correlating the survey information to the network structure.

4.7.5 Preparedness analysis

The preparedness analysis uses a standardised evaluation framework to compare Swedish oil spill preparedness to other countries. Such a framework consists of a checklist of measures in various configurations depending on the organisational level (national, regional, local, or industry), with multiple-choice answers and an inbuilt analysis tool.

4.7.5.1 RETOS™

RETOS™ version 2.0 is an Excel tool based on original work developed for the ARPEL Governance Project (Taylor et al., 2014; Taylor & Lamarche, 2014; Taylor, Steen, Meza, Couzigou, Hodges, Miranda, Ramos, & Moyano, 2008a; 2008b). It provides a general guide for industry and governments to assess their level of oil spill response, planning, and readiness management in relation to pre-established criteria, and international best management practices. This is the only such tool that was found and is backed by regional and international experts from industry and government, such as Clean Caribbean and Americas (CCA), the Regional Activity Center - Regional Marine Pollution Emergency Information and Training Center for the Wider Caribbean (RAC-REMPEITC-Caribe), IMO, Oil Spill Response Limited (OSRL), the Caspian and Black Sea's Oil Spill Preparedness Regional Initiative (OSPRI), the Global Initiative for West, Central and Southern Africa (GI WACAF), and the International Petroleum Industry Environmental Conservation Association (IPIECA).

4.8 Conclusions

Working from the underlying philosophy, through research design and methods, and finishing in explanations of the analyses performed, this chapter explains the reasoning from research approach through design, methods, data collection, and analysis. The epistemological and methodological background for conducting the research is justified, and builds on the background and literature review presented in Chapters 2 and 3. Hypotheses testing in the forthcoming results chapters are justified. Research quality is discussed in the form of potential and real threats to validity and reliability, and how these are managed. Finally, research methods and tools are described technically and justified.

The research process in this dissertation follows a deductive progression from describing the current state of Swedish oil spill preparedness, to identifying patterns, testing causative theories, and generalising findings.

Chapter 5 - Management

The first of the five results chapters focuses on the oil spill preparedness topic of management and specifically the Swedish management structure. The roles of the different institutions are introduced and analysed, and the oil spill preparedness network is mapped and compared to the survey responses. This is the only foundation component with its own chapter, as the research and funding are discussed in relation to the prevention, planning, and response topics in Chapters 6 to 8.

5.1 Introduction

An effective preparedness is not necessarily dependent on large amounts of oil spill materials and equipment (ITOPF, 2012b). Most importantly, infrastructure, logistical support, and leadership are needed to effectively respond to an oil spill.

5.1.1 Organisational structure

Experience has shown that an oil spill response can be effective even with basic equipment and resources, on the conditions that the organisational structure is clearly defined and understood by those involved and the response work itself is well managed (ITOPF, 2012b). Thus, an organisational structure is required that provides informed leadership for difficult decisions under time pressure and accommodates compromises during both planning and response. This structure will also be responsible for managing the diverse expectations and demands from the media and different governmental, private, and public organisations involved (ITOPF, 2012b).

Overcoming the issues of coordination and management of the various organisations involved in oil spill preparedness is preferably done before an actual spill. All affected parties should be part of the oil spill contingency planning process. Negotiating priorities and decisions during an ongoing response will impede the successful outcome of an operation. An effective organisational structure includes the involved organisations and makes them work together as a unit toward the common goal of minimising the oil spill impact. This requires a clear command structure with unambiguous roles and responsibilities, and effective leadership (ITOPF, 2012b). A clearly defined and established command and management structure will significantly reduce confusion and misinformation during an oil spill response (Purnell & Zhang, 2014).

Different management systems are used in different parts of the world. These have often been developed from local preferences and previous oil spill experience. Regardless of the organisational system, four functions are essential to include in a response organisation (ITOPF, 2012b):

1. ***Management***
   Leading overall response and individual operations, for example at sea and on land.

2. ***Planning***
   Structuring future operations based on current and forecasted situations, including the availability of resources and local sensitivities.

3. ***Logistics***
   Operations support with equipment and qualified personnel.

4. ***Administration***
   Record keeping, financial control, and other administrative tasks, for example compilation of claims.

There are two general organisational models for oil spill response, the Team-based structure and the Function-based organisational structure (ITOPF, 2012b).

5.1.1.1 Team-based structure

The Team-based structure (see Figure 23) has been used successfully in various parts of the world (ITOPF, 2012b).

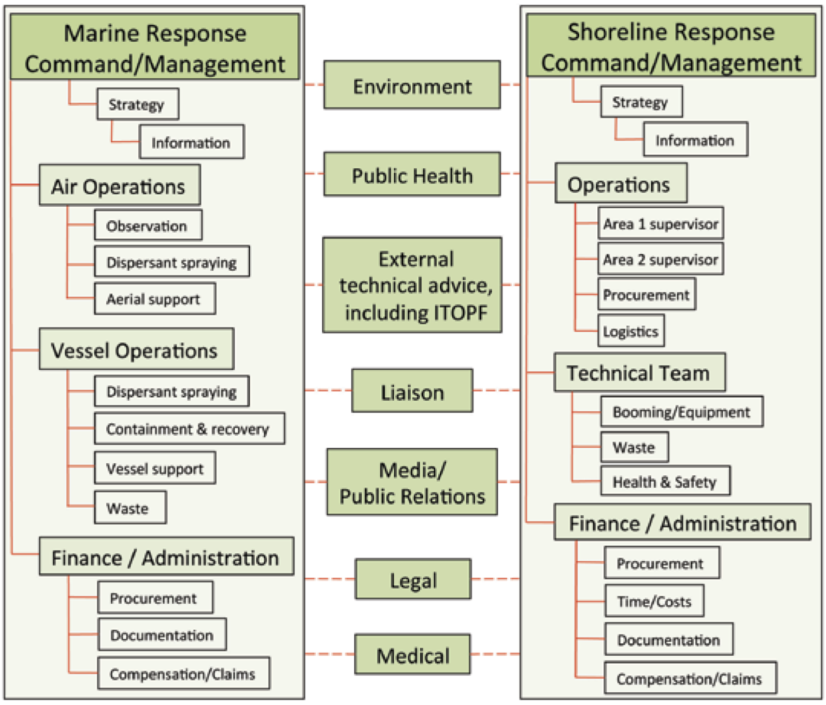

Figure 23: Team-based structure for oil spill response (ITOPF, 2012b). Information refers to state of the casualty, the location of spilt oil, shoreline impact, the weather etc. Figure used with permission.

Its main principles are shared with the Function-based structure, but the Team-based approach is more focussed on individual organisations and teams are not assigned based on function. Instead, positions are based on the different mandates of the organisations, commonly at sea and onshore, with accompanying support. This structure makes the teams independent, but also less coordinated with the overall response organisation. Only a few overarching tasks (for example public health, media, and legal issues) are shared with other organisations, necessitating establishment of liaison officers and to some extent, duplicating management and administration work.

5.1.1.2 Function-based structure

The Function-based structure (see Figure 24), also known as the Incident Management System (IMS), is best exemplified by the Incident Command System (ICS) used primarily in the United States (Buck, Trainor, & Aguirre, 2006; ITOPF, 2012b; Jamieson, 2005).

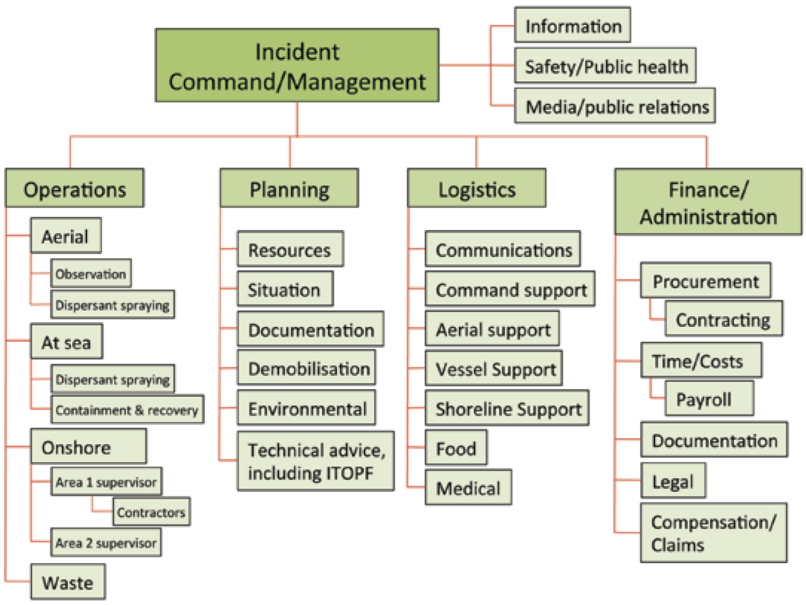

Figure 24: Function-based structure for oil spill response (ITOPF, 2012b). Information refers to state of the casualty, the location of spilt oil, shoreline impact, the weather etc. Figure used with permission.

The Function-based structure focuses on the roles and functions that are needed for an effective response. It is designed specifically for disaster responses that require personnel from different organisations and agencies to work together in a single structure with predetermined roles and responsibilities. All relevant organisations should be familiar with the ICS structure, which enables a response organisation to be built quickly. For example, it is the United States Coast Guard (USCG) that will be appointed as the Incident Command and lead the response for any oil spill accidents in territorial waters and Exclusive Economic Zone (EEZ) of the United States, with the other functions being filled by qualified individuals from other agencies, the industry, and volunteer organisations. The ICS structure has been adopted by the Philippines, Brunei, Ireland, Saudi Arabia, and Canada (Curd, 2013), and has been endorsed by the International Maritime Organization (IMO) (IMO, 2012) and industry, for example Oil Spill Response Limited (OSRL) and Shell (Curd, 2013; OSR, 2013).

5.1.2 Organisational theory

There are predominantly two perspectives on organisational theory: the rationalist perspective and the social-psychological perspective. From a rationalist perspective, organisations can be described as systematically established structures, invented to accomplish specific goals (Abrahamsson, 1992). The important structures in this perspective are the formal structure and authority, responsibility, competence, and coordination (Ödlund, 2007; 2010). The social-psychological perspective targets personal interactions and interaction with the environment. This perspective focuses on social psychology in the form of identity and culture, and socio-biology in the form of trust. The mainly top-led and politically derived framework and conditions in an organisation (the rationalist perspective) interact with the mechanisms that govern human behaviour and interaction (the social-psychological perspective).

The Function-based structure (IMS) is built around a hierarchical chain of command and the unity of command concept (IPIECAOGP, 2014a). This concept means that every individual has only one designated superior officer, giving a clear point of contact and minimising the possibility of contradictory and confusing orders. The Function-based structure also uses a common terminology, to minimise misunderstandings between organisations during a response.

Much of the research on the Function-based structure has naturally been done in the United States. The United States' management organisation, before implementation of ICS in 2004 (Moynihan, 2009), was similar to the current management structure in Sweden. The United States federal government did not require any specific management structure to be used by emergency response organisations on state and local level (Lindell, Perry, & Prater, 2005). This resulted in several different organisational structures, position titles, and operational procedures that impeded cooperation, even among the same response agencies (e.g. fire departments) in neighbouring areas. A criticism against non-Function-based structure systems is that in case of an event requiring cooperation with unknown organisations, valuable time is lost trying to overcome differences in organisational training, design, procedures, and titles (Lindell et al., 2005).

Crisis management in Sweden is mainly decentralised and the responsibility is delegated by the government to individual municipalities and their rescue services (Ödlund, 2010). The organisational structure follows the *responsibility principle*, in that the organisation responsible for an activity during normal conditions retains that responsibility during a crisis situation. Additionally, the structure follows the *subsidiarity principle*, which states that crises should be managed close to the citizens. This means that the local authorities should handle the crisis, reinforced by national resources, rather than being taken over by a national agency.

The traditional method for managing cross-sector activities is cooperation with other organisations towards a common goal. The Swedish system of institutional structures makes the agencies legally equal and no organisation is above another. Cooperation is the only management option (Norberg, Ryghammar, and Hedberg, 2005, cited by Ödlund (2007; 2010) and Swedish agencies are obliged legally to cooperate during crises (Regeringen, 2006b), making cooperation a central issue in preparedness.

5.1.3 Network theory

The definition of network follows Kupucu (2005):

"A network is a group of individuals or organizations who, on a voluntary basis, exchange information and undertake joint activities and who organize themselves in such a way that their individual autonomy remains intact. In this definition important points are that the relationship must be voluntary, that these are mutual or

reciprocal activities, and that belonging to the network does not affect autonomy and independence of the members."

Network theory is used to map relationships between individuals, organisation or other entities and is used for analysis of interacting groups, in this case the Swedish oil spill preparedness network.

5.1.4 Swedish formal organisation

The Swedish oil spill response organisation, the operational part of oil spill preparedness, follows the Team-based structure (see Figure 23) by having the sea response separate from the onshore response (see Figure 25).

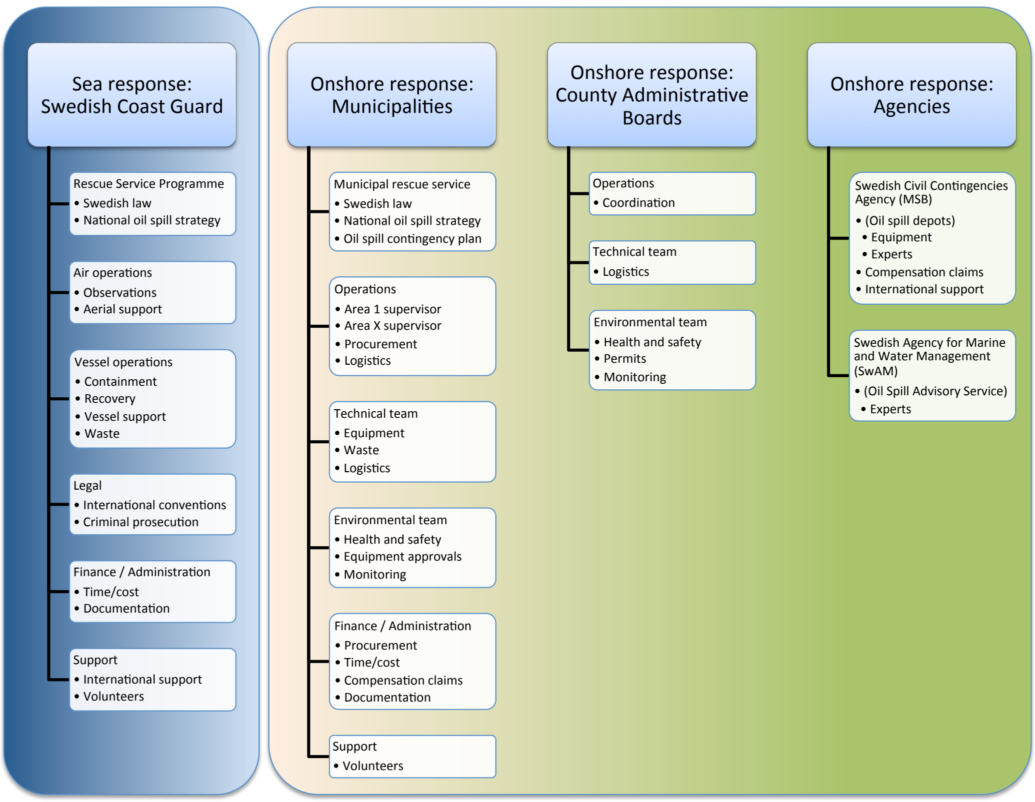

Figure 25: The formal oil spill response organisation in Sweden.

The onshore response is formally a municipal responsibility, but certain tasks are shared between the municipalities, the County Administrative Boards (CABs), and various governmental agencies.

In practice, this arrangement is not followed strictly. The line between the Swedish Coast Guard's (SCG) and the municipalities' responsibilities are formally the division between land and sea (Regeringen, 2007c; Sveriges Riksdag, 2003). However, the practical situation is that both organisations work on oil spills on the shoreline (MSBHaV, 2014). Reports (Baltic Master, 2006; Danielsson et al., 2012; MSB, 2013a) and evaluations (MSBHaV, 2014; Riksrevisionen, 2006) have highlighted the need to clarify this division of responsibilities, as the practical situation has undermined the formal arrangement.

The Swedish Maritime Administration (SMA) and the Swedish Transport Agency (STA) also have responsibility at sea. However, this is more related to shipping and not directly to oil spill preparedness. They are consequently not directly part of the formal oil spill response organisation.

Similarly, on land, the Swedish Environmental Protection Agency (EPA), the Swedish Armed Forces (SAF), and Police have more general responsibilities, but nothing dedicated to oil spill preparedness. Consequently, they are not part of the formal organisation either.

5.2 Methods

Chapter 5 analyses how the Swedish oil spill preparedness regime is organised and managed, and examines if the management during the preparedness planning and response phases is sufficient.

The analysis has followed the rationalist perspective and thus examines the effectiveness of the oil spill management structure.

5.2.1 Study design

The issues above are covered in Hypothesis 1, H1:

H1 – The preparedness regime is sufficiently managed

Which gives the null hypothesis:

$H1_0$ – The preparedness regime is insufficiently managed

Hypothesis 1 was chosen to analyse the organisation of Swedish oil spill preparedness, its structure, and division of responsibilities. The units of analysis have been chosen based on reasoning and practicality after consulting literature and expert opinions.

The responsibilities of the organisations are determined by their mandates, regulated through law or governmental instructions. The number and shape of the network connections determine the structure of the organisational network. The impression of an organisation is determined by three factors: how other organisations understand the role and responsibilities of the organisation, how valuable the organisation is perceived to be to other organisations, and the expectations of the other organisations. The relationship between the units of analysis and their corresponding variables can be seen in Figure 26.

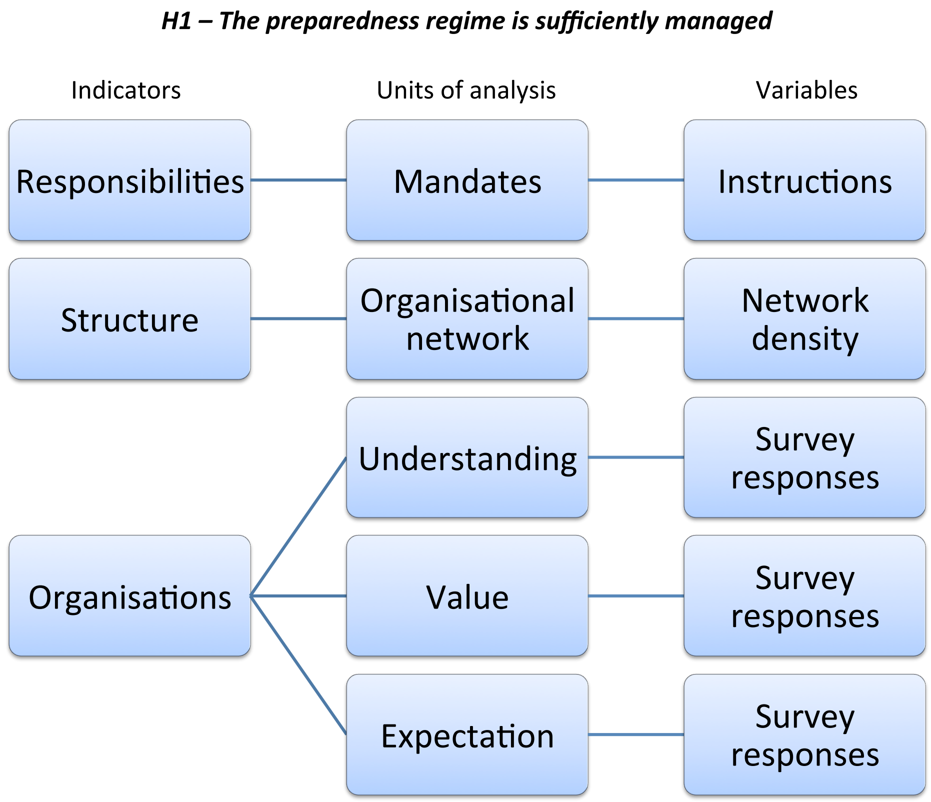

Figure 26: Hypothesis 3 chosen indicators, units of analysis, and variables.

If the Swedish oil spill preparedness system is effectively managed, the organisational structure follows a logical path tied to the organisational responsibilities, which everyone understands. Additionally, the organisations involved know their roles and responsibilities in this system. In order for such a structure to be effective, it has to be communicated and exercised, as structures and responsibilities may be unknown outside of the organisation. However, no organisation can act alone if a large oil spill occurs and knowledge of the other organisations involved is a requirement for effective oil spill preparedness.

These criteria have been quantified in Table 5, following to the rationale for ranking the variables in Chapter 4.

Table 5: Evaluation criteria for H1.

	Preferable	*Sufficient*	*Insufficient*
Mandates	95% or more of the governmental organisations have oil spill responsibilities in their mandate.	From 50% up to 95% of the governmental organisations have oil spill responsibilities in their mandate.	Less than 50% of the governmental organisations have oil spill responsibilities in their mandate.
Planning network density	95% or more of the maximum possible planning connections between the agencies, CABs, and municipalities.	50% up to 95% of the maximum possible planning connections between the agencies, CABs, and municipalities.	Less than 50% of the maximum possible planning connections between the agencies, CABs, and municipalities.
Response network density	95% or more of the maximum possible response connections between the agencies, CABs, and municipalities.	50% up to 95% of the maximum possible response connections between the agencies, CABs, and municipalities.	Less than 50% of the maximum possible response connections between the agencies, CABs, and municipalities.
Responses for understanding	Respondents consider organisational roles well understood, 95% or more of the maximum score.	Respondents consider organisational roles understandable, from 50% up to 95% of the maximum score.	Respondents do not consider organisational roles understandable, less than 50% of the maximum score.
Responses for planning values	Respondents consider most existing organisations valuable for planning, 95% or more of the maximum score.	Respondents consider existing organisations valuable for planning, from 50% up to 95% of the maximum score.	Respondents consider most existing organisations not valuable for planning, less than 50% of the maximum score.
Responses for response values	Respondents consider most existing organisations valuable for response, 95% or more of the maximum score.	Respondents consider existing organisations valuable for response, from 50% up to 95% of the maximum score.	Respondents consider most existing organisations not valuable for response, less than 50% of the maximum score.
Responses for planning expectations	Respondents consider organisational responsibilities for planning to meet expectations, average score up to +/- 0.25.	Respondents consider organisational responsibilities for planning to be close to expectations, average score from +/- 0.25 to 1.0.	Respondents do not consider organisational responsibilities for planning to meet expectations, average score below -1.0 or over 1.0.
Responses for response expectations	Respondents consider organisational responsibilities for response to meet expectations, average score up to +/- 0.25.	Respondents consider organisational responsibilities for response to be close to expectations, average score from +/- 0.25 to 1.0.	Respondents do not consider organisational responsibilities for response to meet expectations, average score below -1.0 or over 1.0.

These levels correspond to if a variable is wholly present and/or functioning (*Preferable*), partially present and/or functioning (*Sufficient*), or not present and/or functioning at all (*Insufficient*). All of the units of analysis will have to demonstrate that they at least reach the rank of *Sufficient* for H1 to be accepted, meaning that oil spill preparedness is sufficiently managed, but should be further developed. If all variables are ranked *Preferable*, oil spill preparedness is managed at the best practice level. If any of the variables are ranked *Insufficient*, the management is missing an important factor, negatively impacting Swedish oil spill preparedness.

5.2.2 Sources

Primary information has been collected from the questionnaire (see Appendix A - Questionnaire) distributed to all coastal municipalities and County Administrative Boards (CABs), and the interviews (see Appendix B - Interview) with the members of the National Cooperation Group for Oil Combating (NSO). NSO consists of representatives from the Swedish Coast Guard (SCG), the Swedish Civil Contingencies Agency (MSB), the Swedish Agency for Marine and Water Management (SwAM), the Oil Spill Advisory Service (OSAS) at Sweco, the Swedish Maritime Administration (SMA), the Swedish Transport Agency (STA), the County Administrative Boards (CABs), and the Swedish Association of Local Authorities and Regions (SALAR).

Data was also collected from publicly available sources online, primarily government websites. Response evaluations have been obtained directly from the organisers or evaluators, if not publicly available. Scientific papers have been acquired through the library at the World Maritime University (WMU) and open access journals online.

5.2.3 Analysis

The connection data from the survey has been visualised as an organisational network in the Gephi programme version 0.8.2 beta (Bastian et al., 2009). The layout used is ForceAtlas2, with scaling value 100 and overlap avoidance (Jacomy, Venturini, Heymann, & Bastian, 2014). This layout is used to separate and cluster the involved organisations depending on their connections to other organisations. The data was mapped by eigenvector centrality and analysed using statistical methods for network theory (Newman, 2003). Eigenvector centrality assigns each node a centrality based on both the number and the quality of its connections. The theory assumes that influence is proportional to connections (Newman, 2008). Having a large number of connections is important, but a node with a smaller number of high quality contacts may outrank one with a larger number of average contacts. In this way, the influence of the organisations is reflected in their rank and is visualised by a difference in node size. The popular search engine Google uses an algorithm called Page Rank based on eigenvector centrality ranking. Network density measures the number of connections between nodes and divides that number by the maximum number of possible connections. All nodes connected to all other nodes would be 1.00.

5.3 Results

Formal mandates and evaluations of oil spill exercises and real spills have been analysed to identify the formal and practical responsibilities of the various organisations. Data from the questionnaire have been compiled and analysed to map and examine the connections between the different organisations involved in oil spill preparedness.

5.3.1 Mandates

Several organisations are involved in oil spill preparedness in Sweden. The main actors and their mandates are described below.

5.3.1.1 Swedish Coast Guard (SCG)

SCG is responsible for monitoring state waters, maritime security, and for rescue services (including environmental protection) at sea and in the largest Swedish lakes: Vänern, Vättern, and Mälaren (Regeringen, 2007c). The agency operates 25 coastal stations, 30 vessels, and 3 aircraft. SCG is responsible for several international conventions and agreements on border control, maritime security, and marine environmental protection. This includes oil spill response, such as the International Convention on Oil Pollution Preparedness, Response and Co-operation (OPRC Convention), and the Convention on the Protection of the Marine Environment of the Baltic Sea Area (Helsinki Convention). SCG also represents Sweden in international forums, such as the Helsinki Commission (HELCOM) and Convention for the Protection of the Marine Environment of the North-East Atlantic (OSPAR Convention) for oil spill related issues. The Governmental instructions explicitly state that SCG should be able to respond to an oil spill of up to 10,000 tonnes (Regeringen, 2007c).

5.3.1.2 Swedish Civil Contingencies Agency (MSB)

MSB is responsible for civil protection, crisis management, and disaster preparedness in Sweden. It is mandated to encourage and coordinate efforts, and oversee training, exercises, and evaluations to improve national disaster preparedness. However, the agency does not have specific instructions to lead any response, following the subsidiarity principle. MSB is required to provide expert advice and logistics assistance in case of serious accidents, including oil spills. Furthermore, it has the mandate to supply international assistance and represent Sweden in international disaster management operations. For oil spills, this covers for example the Emergency Prevention, Preparedness and Response Working Group (EPPR) of the Arctic Council and the Response Working Group (HELCOM RESPONSE) of HELCOM. MSB is responsible for the development of national oil spill preparedness strategies (Kulander et al., 2004; NSO, 2014b) and handles damage claims related to oil spills. The agency is also responsible for equipping and maintaining the Oil Spill Depots, described below. In practice, MSB has been more involved than its mandate suggests, by participating actively as experts and advisors during past oil spill response operations (MSBHaV, 2014).

5.3.1.3 Oil Spill Depots (Depots)

MSB maintains five mobile oil spill equipment depots and a central supply depot. The equipment consists of personal protection, skimmers, pumps, All-Terrain Vehicles, small boats, booms, and sorbents (Forsman, 1997). The equipment is preloaded in containers for swift distribution. The central depot is located in Kristinehamn and the mobile Depots were stationed in local rescue services in Botkyrka, Karlskrona, Umeå, Visby, and Vänersborg until April 2015. They have now been relocated to the SCG stations in Djurö, Gothenburg, Härnösand, Oskarshamn, and Slite (Söder, 2015). The intent was to be able to transport equipment 250 km within 10 hours to reinforce local rescue services in case of oil spills, effectively covering all Swedish coasts (Forsman, 1997). The response capacity of the Depots is discussed in Chapter 8.

5.3.1.4 Swedish Agency for Marine and Water Management (SwAM)

SwAM is a young agency, founded in July 2011. The agency has general responsibility for marine issues, but does not have any explicit responsibility for oil spill planning or response in its mandate (Regeringen, 2011b). The agency represents Sweden in international marine environmental forums, such as the environmental protection working groups of the Arctic Council, HELCOM and OSPAR. SwAM is responsible for *Swedish Environmental Objective 10: A Balanced Marine Environment, Flourishing Coastal Areas and Archipelagos*, which include discharges of oil and chemicals (Environmental Objectives Council, 2006). However, the Swedish Environmental Objectives do not prescribe any specific way to reach the targets, and do not prescribe any particular means to achieve them and is basically a reporting task. In practice, SwAM has been more involved than its mandate suggests in giving advice to oil spill response organisations (MSBHaV, 2014). This has probably contributed to confusion regarding SwAM's role, as discussed later in this chapter. SwAM was responsible for the Oil Spill Advisory Service (OSAS) until the end of 2014, described below.

5.3.1.5 Oil Spill Advisory Service (OSAS)

OSAS is a service under contract from SwAM to the consultancy company Sweco and previously IVL, another consultancy company. The contract expired at the end of 2014 and was not renewed by SwAM (NSO interviews, January 2015). The specialists attached to OSAS acted on SwAM's behalf as experts on oil and chemical accidents at sea and in inland waters. These specialists possess a broad knowledge of oil spill risks, preparedness, response, chemistry, toxicology, and monitoring. OSAS gave expert advice and information to public administration and agencies regarding oil spills. With larger oil spills, it could assist on site.

5.3.1.6 Swedish Maritime Administration (SMA)

SMA has responsibility for the shipping routes in Sweden, including minimising environmental impacts (Regeringen, 2007d). The Administration has no direct mandate for oil spill response, but is obliged to secure shipping routes and to warn ships approaching a maritime casualty, for example a ship leaking oil.

5.3.1.7 Swedish Transport Agency (STA)

STA is responsible for regulations, enforcement, and permits in the transport sector (Regeringen, 2008c). This includes ratification of international rules, such as international conventions, into Swedish legislation. It has no explicit instructions for oil spill response, but is responsible for a number of international agreements and represents Sweden in international transport forums, such as IMO for shipping issues. These rules are enforced using shipping inspectors, which assess shipping accidents, with potential oil spills.

5.3.1.8 Environmental Protection Agency (EPA)

EPA has general responsibility for environmental issues concerning climate, biodiversity, waste, and waste water management, but has no explicit responsibility for oil spill preparedness (Regeringen, 2012b). OSAS was originally under contract by EPA, but this responsibility was carried over to SwAM, when the new agency was created in 2011. EPA has explicit instructions to cooperate with SwAM on marine issues, but it is not specified to what extent and in which areas this collaboration should take place. However, it was decided during 2015 that the EPA would be responsible for oiled wildlife response.

5.3.1.9 Swedish Armed Forces (SAF)

SAF is responsible for the military defence of Sweden (Regeringen, 2007b). It does not have any civil responsibility, but is explicitly instructed to support civil agencies in cases of emergencies as far as it is able. In practice, the Armed Forces was involved in both the *Fu Shan Hai* accident (Ljungkvist, 2003) and the Tjörn oil spill by contributing with manpower, management, and logistics (MSBHaV, 2014). In particular, SAF's experience in setting up robust long-term command staff organisations, and the contribution of enlisted personnel as a work force have been appreciated during these responses.

5.3.1.10 Swedish Police

The police is responsible for enforcing national laws and investigating criminal offences (Regeringen, 2014c). It has no explicit mandate for oil spill preparedness and response, but helps to maintain security around oil spill accidents. This service was needed during the *Fu Shan Hai* response, where the police helped to maintain control of the traffic to and from the affected areas (Ljungkvist, 2003).

5.3.1.11 County Administrative Boards (CABs)

CABs represent the Swedish Government at the regional level and are responsible for coordination of all national goals, including environmental protection and disaster management in their respective counties (Regeringen, 2007e). A Governor appointed by the Government leads each CAB. The smallest counties represent 5 municipalities and the largest 49 municipalities. As such, they are not a specialised authority, but have the responsibility to coordinate emergencies covering more than one municipality. CABs can, if needed, designate an officer to lead emergency response across several municipalities (Sveriges Riksdag, 2003). However, this is usually a suitable rescue service officer from one of the municipality, rather than a CAB employee. CABs are required to have an officer on call to respond to any crisis affecting the county, by initiating alarm procedures and disseminating information. Another requirement is to prepare a risk assessment of potential risks in the county, which includes oil spills.

5.3.1.12 Municipalities

The municipalities are the local governments and are fairly autonomous authorities in Sweden. They are led by elected officials and responsible for local services such as schools, emergency services, and physical planning. They are organised into several offices, for example the rescue service, the technical office, and the environmental office. The rescue service and the municipality offices can in some circumstances be considered to be separate organisations, especially when dealing with Rescue Service Associations consisting of several municipalities, but are still part of the same municipality. Municipalities are required by law to have an action plan for rescue services, which should include a risk assessment of possible threats and the municipal capacity to handle emergencies (Sveriges Riksdag, 2003). They are also required to have a rescue service dealing with these emergencies, but the types of emergencies are not listed. The emergencies are defined as (unofficial translation):

"… rescue services that the State or Municipalities are responsible for after an accident or impending risk of an accident to prevent or limit damage to people, property or environment."

However, municipalities are not required to have an oil spill contingency plans or oil spill response equipment (MSBHaV, 2014; Sveriges Riksdag, 2003), but are recommended to have them by MSB (Kulander et al., 2004). Oil spills are only specifically mentioned once in the legal act regulating protection from accidents, clarifying that municipalities could be reimbursed by the state if undertaking oil spill clean-up (Sveriges Riksdag, 2003).

5.3.1.13 Volunteers

There are several different volunteer organisations, for example the Swedish Sea Rescue Service (SSRS), that deal with lifesaving at sea and work closely with SCG, and the Swedish Wildlife Rehabilitators Association (Katastrofhjälp Fåglar och Vilt, KFV), who care for injured animals, including animals that have been oiled. Some of these organisations have cooperation agreements with a municipality, CAB, or an agency. These organisations do not have any formal responsibility in oil spill preparedness, but are of great value as they are often trained and organised professionals, and have unique knowledge and equipment in their specific areas of expertise. However, the exclusion of the volunteer organisations from the formal organisation has made notification and inclusion of them sporadic (Ljungkvist, 2003; MSBHaV, 2014).

5.3.1.14 Industry

There are a number of industry actors involved, for example ports, shipping companies, and oil companies. Industries only have responsibilities for oil spill planning and response for spills inside their own geographic area, for example a port or a refinery (Regeringen, 1998). However, especially the larger ports are involved in municipal contingency planning and response to some degree, as some ports and municipalities have agreements to assist each other with personnel and equipment in case of oil spills. These ports have no formal part in oil spill contingency planning and their equipment is not usable by the municipalities, unless some kind of agreement exists. Clean-up companies are another industry will likely become involved during a large oil spill response. In Sweden, the clean-up companies are hired as temporary contractors by the municipalities if there is an oil spill and do not have a dedicated role. Few contracts have been setup in advance. No companies are currently drilling for oil in Swedish territorial waters or EEZ. Few shipping or oil companies have direct contact with the municipalities, except if they own any land-based infrastructure. Shipping and oil companies are not part of the formal oil spill response management, contrary to the common situation abroad, for example in the United States.

5.3.1.15 Others

Other stakeholders involved are various authorities abroad, for example in Norway and Finland. These represent the governmental authorities and agencies, which are responsible for oil spill planning and response. They do not have any formal responsibilities in Sweden, but are obliged to give assistance to Swedish municipalities and agencies through the international conventions and regional agreements described in Chapter 6, such as HELCOM (HELCOM, 2008) or the Copenhagen Agreement (Copenhagen Agreement, 1993). This group also includes individual fishermen, who may become involved during an oil spill response. Fishermen have no formal place in the response network and have not been found to have ever been utilised during any oil spill response (Ericsson, M., email communication, 11 November 2015). They could potentially be used during the clean up phase, contracted by the municipality.

5.3.1.16 Conclusion

The survey responses showed that 70% of the agency representatives agreed that they had a mandate for either contingency planning or response (see Table 6). However, there is room for interpretation of this mandate, as oil spills are only explicitly mentioned as a task in the instructions to SCG (Regeringen, 2007c). For the other organisations, wording concerns disasters and crises or are expressed in general terms of assisting other organisations.

Table 6: Summary of organisational mandates and the survey responses.

Organisation	Planning		Response	
	Respondent	Mandate	Respondent	Mandate
Swedish Coast Guard (SCG)	Yes	Yes	Yes	Yes
Swedish Civil Contingencies Agency (MSB)	No	Yes	Yes	Yes
Swedish Agency for Marine and Water Management (SwAM)	No	No	No	No
Swedish Maritime Administration (SMA)	Yes	Yes	Yes	No
Swedish Transport Agency (STA)		No	Yes	Yes
Environmental Protection Agency (EPA)		No		No
Swedish Armed Forces (SAF)		No		Yes
Police		No		No
CABs		Yes		Yes
Municipalities		Yes		Yes

The discrepancy is even larger among the municipality and the CAB respondents (see Table 7). For planning, 25% of the CAB respondents did not consider themselves to have any responsibility, which this chapter showed to be mandated. For response, 50% of the CAB respondents did not consider themselves to have any responsibility. For the municipality respondents, 17.5% did not consider themselves to have any planning responsibility, which this chapter showed to be mandated. For response, 98% of the municipality respondents recognised that they have a responsibility.

Table 7: Summary of survey mandate responses.

Organisation	Planning		Response	
	Yes	No	Yes	No
CABs	**9**	**3**	**5**	**5**
Municipalities	**47**	**10**	**49**	**1**
- Coastal	*38*	*5*	*39*	
- Lake	*9*	*5*	*10*	*1*
Total	**56**	**13**	**54**	**6**

No larger oil spills have been recorded in the Swedish lakes. Therefore, an analysis of whether lakeside municipalities are less aware of their oil spill preparedness responsibilities than their coastal counterparts was conducted. However, no significant difference was found for planning, Berger's test (N = 57), p = .0744, or for response, Berger's test (N = 50), p = .1573.

5.3.2 Network

The respondents were asked which organisations they work with during contingency planning and response.

5.3.2.1 Theoretical network

A theoretical network (see Figure 27) could be built on the assumption that:

- All agencies work with all other agencies, all CABs, and all municipalities.
- All CABs work with all agencies, the neighbouring CABs, and their own municipalities.
- All municipalities work with all agencies, their respective CAB, and all neighbouring municipalities.

The size of a node corresponds to eigenvector centrality, assumed to be a proxy for network influence. Pink colour denotes agencies, green CABs, and yellow municipalities.

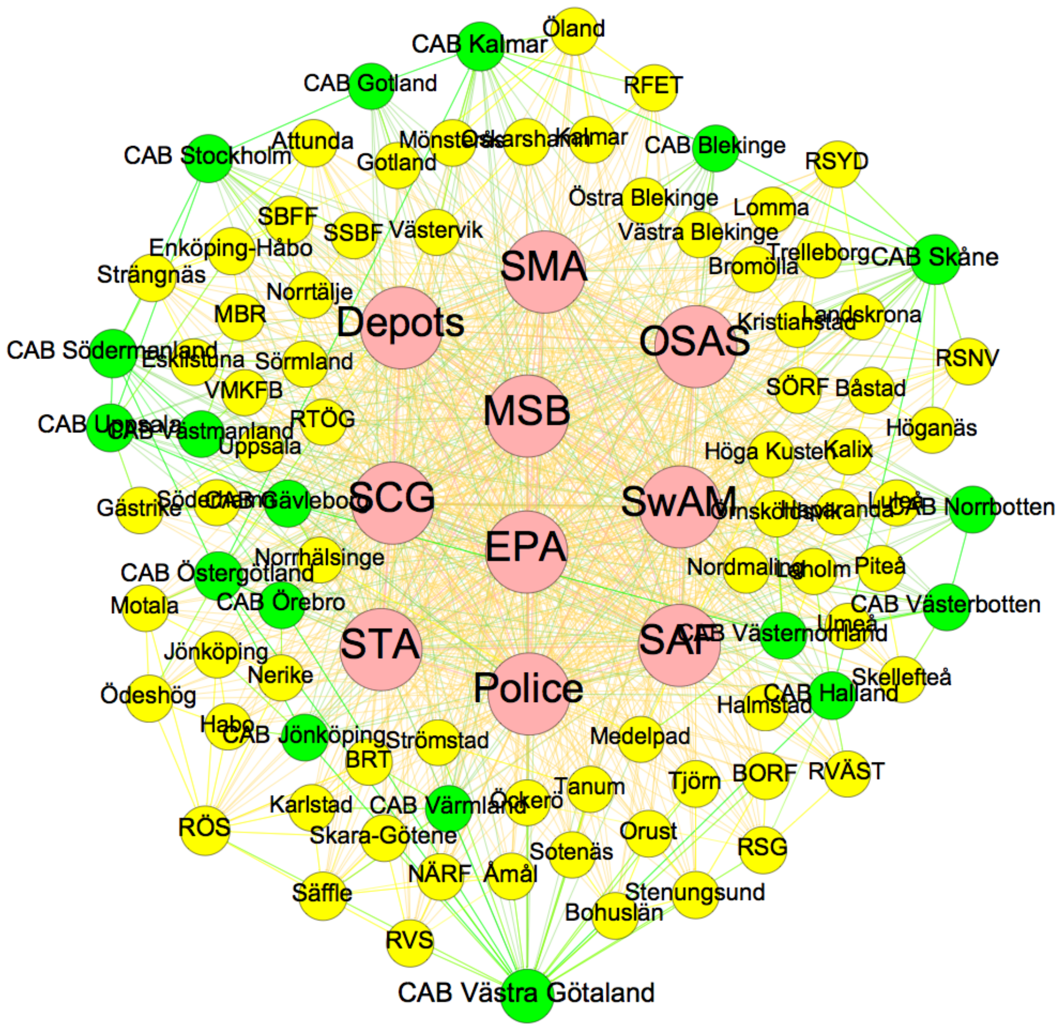

Figure 27: Theoretical oil spill preparedness network.

This network is valid for both planning and response, as these organisations would need information and help from all neighbours and agencies during a large oil spill accident. This network consists of 98 nodes (organisations) and 1,348 edges (connections) with an undirected density of 0.235. This network only reflects the authorities and any connections to industry, volunteers, and others are excluded, as they are not part of the formal response.

5.3.2.2 Planning network

The Swedish oil spill planning network is arranged by relative importance (see Figure 28). The size of a node corresponds to eigenvector centrality, assumed to be a proxy for network influence. Pink colour denotes agencies, green CABs, yellow municipalities, red industries, magenta volunteers, and cyan others.

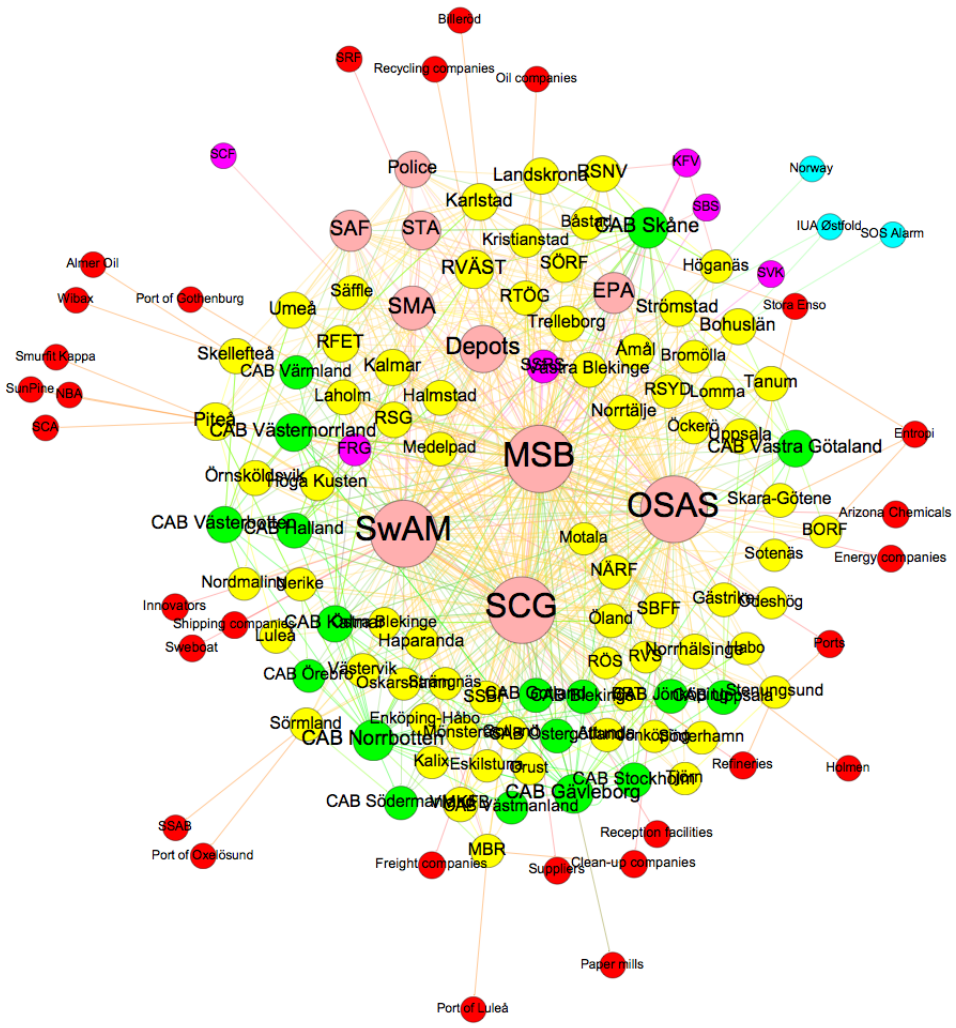

Figure 28: Swedish oil spill contingency planning network.

The central organisations are SCG, MSB, SwAM, and OSAS, surrounded by the municipalities, CABs, and other agencies, with the industry and volunteers in the periphery. The planning network made up by the municipalities, CABs, and agencies consists of 136 nodes (organisations) and 893 edges (connections) with an undirected density of 0.076.

5.3.2.3 Response network

The Swedish oil spill response network is arranged by relative importance (see Figure 29). Size of node corresponds to eigenvector centrality, assumed to be a proxy for network influence. Pink colour denotes agencies, green CABs, yellow municipalities, red industries, orange volunteers, and aqua others.

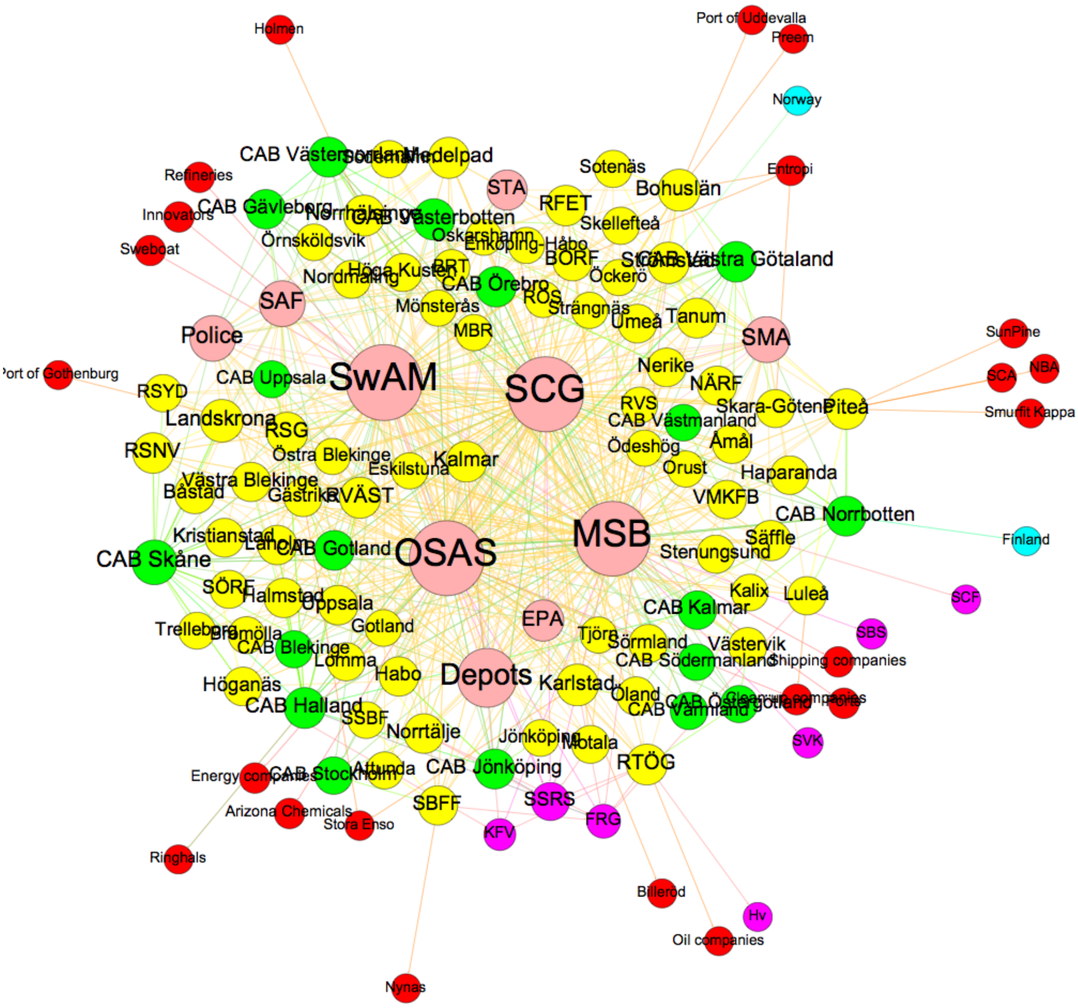

Figure 29: Swedish oil spill response network.

The central organisations are SCG, MSB, SwAM, OSAS, and the Depots, surrounded by the municipalities, CABs, and other agencies. The industry and volunteers are located in the periphery of the network. The response network made up by the municipalities, CABs, and agencies consists of 129 nodes (organisations) and 831 edges (connections) with a density of 0.080.

5.3.2.4 Conclusion

The network densities were recalculated with only the agencies, CABs, and the municipalities, to be able to compare to the theoretical maximum model. The recalculated densities were divided by the number of responses, in order to normalise the results to density per response. The normalised densities for the planning and response networks were then compared to the normalised density for the theoretical maximum to assess similarity (see Table 8).

Table 8: Network densities and normalised values.

	Density	Agency responders	CAB responders	Municipality responders	Sum responses	Normalised density	%
Theoretical max	**0.235**	*10*	*18*	*70*	**98**	0.002398	***100.0 %***
Planning	**0.133**	*6*	*10*	*51*	**67**	0.001985	***82.8 %***
Response	**0.127**	*6*	*9*	*45*	**60**	0.002117	***88.3 %***

The results show that the planning network is 82.8% and the response network is 88.3% of the theoretical maximum. As the links to the agencies and from the municipalities to their respective CABs are present in all networks, the missing links are primarily between neighbouring municipalities and between neighbouring CABs.

5.3.3 Understanding

Understanding in this dissertation means the respondents' perceptions of how well the organisations involved in oil spill preparedness understand the intended roles of the other organisations. These data correspond to the agreement from the questionnaire to the statement *"The role of this organisation in oil spill preparedness is well understood by the others.".* The agreement scale ranges from *Strongly disagree* (-2), *Disagree* (-1), *No opinion* (0), *Agree* (+1), and *Strongly agree* (+2).

The values of the organisations were compiled and graphed with standard deviations (see Figure 30).

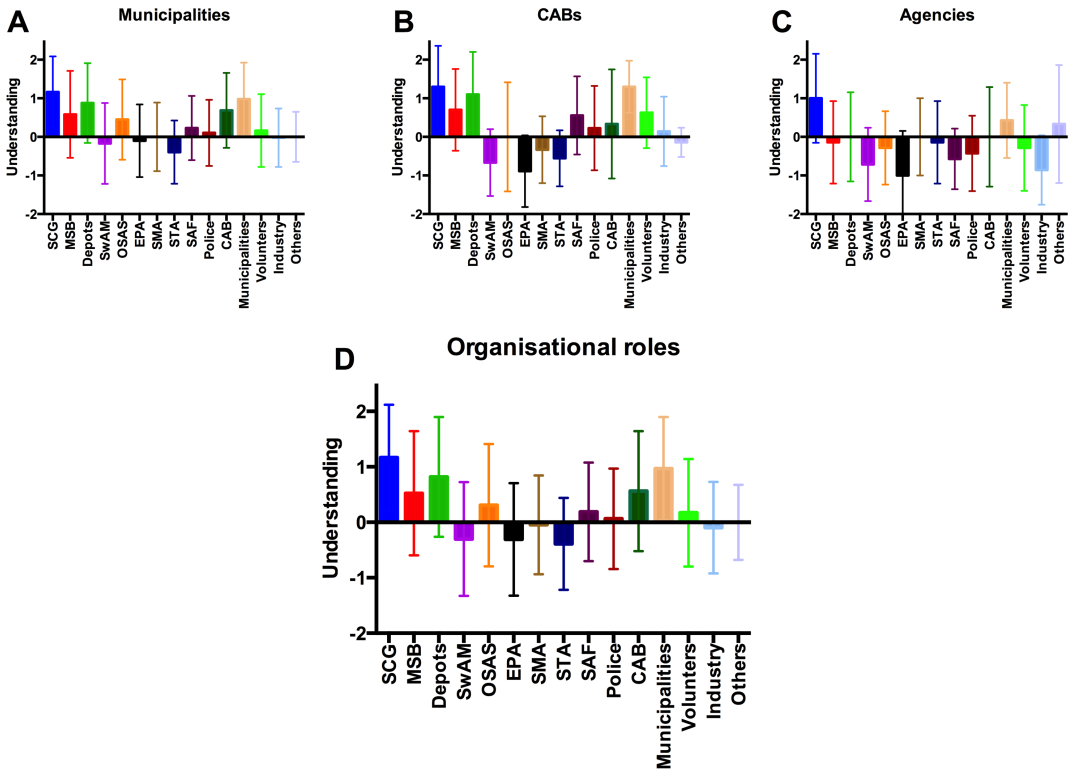

Figure 30: Understanding of the roles of the organisation involved in oil spill preparedness. Error bars signify standard deviations.

In general, the respondents consider the practical organisations, such as SCG, MSB, the Depots and the municipalities to be well understood (see Figure 30 A, B, and D). The roles of SwAM, EPA, and STA are not well understood (see Figure 30 A, B, C, and D). It is interesting to note that the agency responders do not believe that the roles of most agencies are well understood, excepting SCG (see Figure 30 C).

5.3.4 Values

The planning and response values in this context are defined as the worth of an organisation to another for contingency planning and response respectively.

5.3.4.1 Planning value

The data corresponds to survey responses, when asked to identify how valuable the respondents consider these organisations to be in assisting the respondents' organisation with oil spill contingency planning (NOT for oil spill response). The response scale ranges from *Not valuable* (-2), *Limited value* (-1), *Average value* (0), *Valuable* (+1), and *Very valuable* (+2), while the *No opinion* responses have been left out. The values of the organisations were compiled and graphed with standard deviations (see Figure 31).

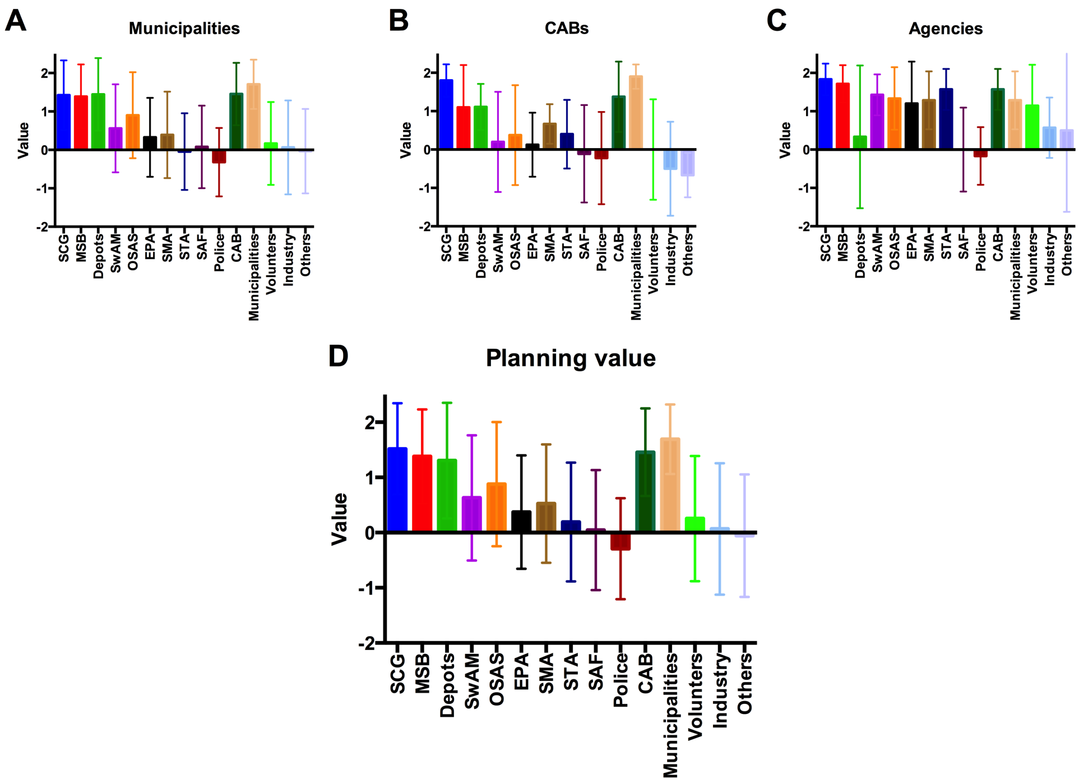

Figure 31: Organisational values for oil spill planning. Error bars signify standard deviations.

The pattern reinforces the results of the network map, with SCG, MSB, the Depots, CABs, and the municipalities as the most valuable organisations to the responders (see Figure 31 D). It is also evident that the municipality and CAB responders generally value only SCG, MSB, the Depots and themselves, and consider the remaining agencies to be of little value (see Figure 31 A and B). In contrast, the agency responders value the agencies as much as they do CABs and municipalities (see Figure 31 C).

5.3.4.2 Response value

The data is based on responses when asked to identify how valuable the respondents consider these organisations to be in assisting the respondents' organisation with oil spill response (NOT for oil spill contingency planning). The response scale ranges from *Not valuable* (-2), *Limited value* (-1), *Average value* (0), *Valuable* (+1), and *Very valuable* (+2), while *No opinion* responses have been left out. The values of the organisations were compiled and graphed with standard deviations (see Figure 32).

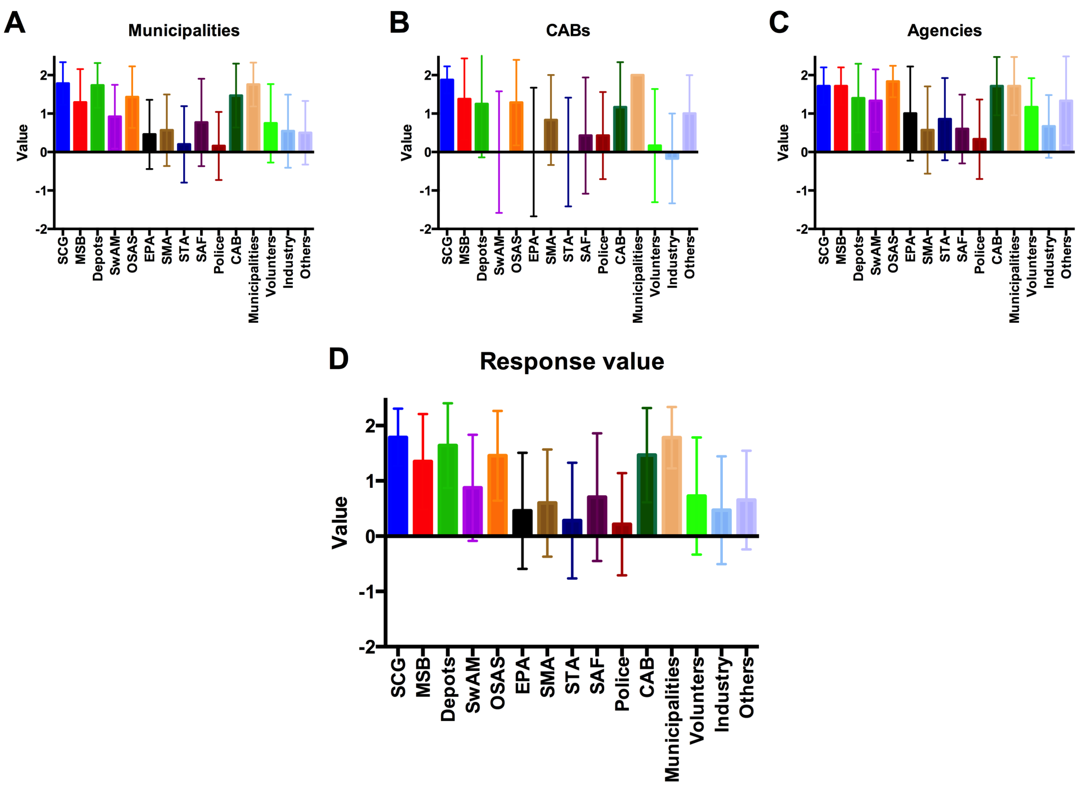

Figure 32: Organisational values for oil spill response. Error bars signify standard deviations.

Similar to the planning pattern, the response pattern reinforces the results of the network map, with SCG, MSB, the Depots, OSAS, CABs, and the municipalities as the most valuable organisations for the respondents (see Figure 32 D). The municipality respondents consider SCG, MSB, the Depots, OSAS, and CABs to be of great value for response (see Figure 32 A). The CAB respondents are less in agreement, but generally value SCG, MSB, the Depots, and OSAS (B). The agency respondents generally value the agencies as much as they do CABs and the municipalities (see Figure 32 C).

5.3.5 Expectations

Expectations in this context means the respondents' opinions regarding what level of responsibility the involved organisations should have, compared to the current responsibilities. The data correspond to the survey responses.

5.3.5.1 Planning expectations

Planning expectations correspond to responses to the question *"What level of responsibility do you think these organisations should have in oil spill contingency planning, compared to today?"*. The response scale ranges from *Greatly decreased* (-2), *Slightly decreased* (-1), *Same as now* (0), *Slightly increased* (+1), and *Greatly increased* (+2), while the *No opinion* responses have been left out. The values of the organisations were compiled and graphed with standard deviations (see Figure 33).

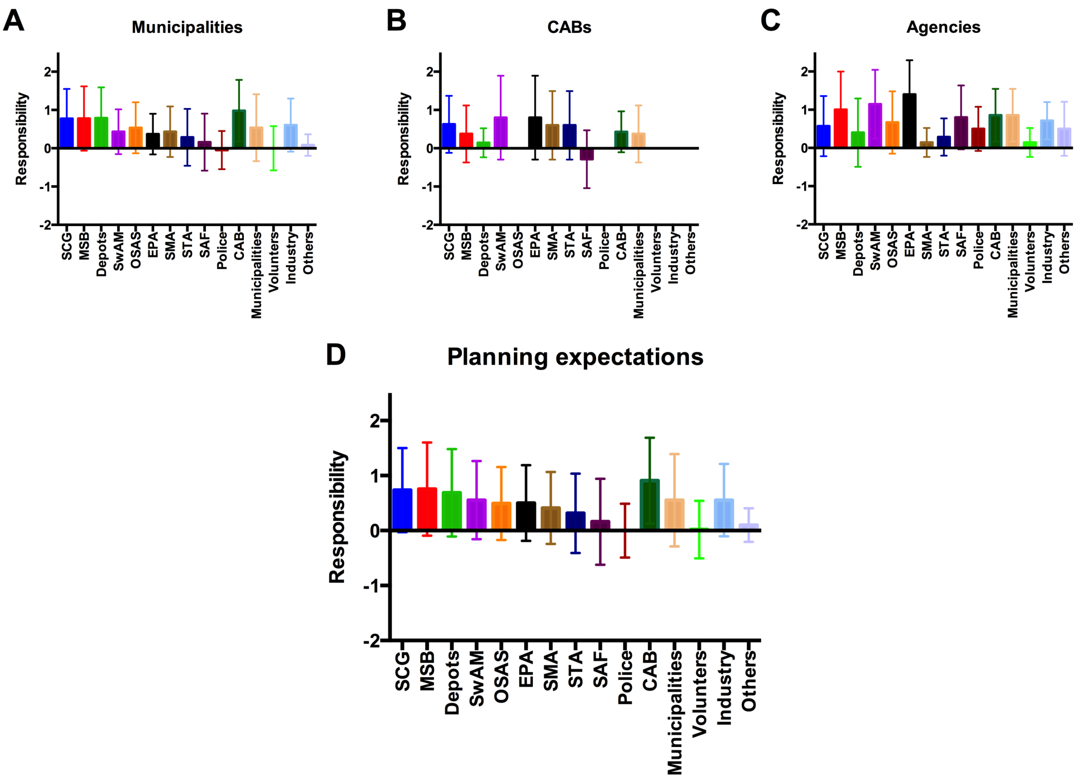

Figure 33: Opinions on the level of responsibility organisations should have for planning. Error bars signify standard deviations.

The pattern and thus the opinions of the respondents vary (see Figure 33 A, B, and C), with the combined opinions showing that CABs should have more responsibility for planning (see Figure 33 D). The agency representatives consider that SwAM and EPA should have more responsibility than they currently have (see Figure 33 C).

5.3.5.2 *Response expectations*

Opinions on the level of responsibility the organisations should have for response, correspond to responses to the question *"What level of responsibility do you think these organisations should have in oil spill response, compared to today?"*. The response scale ranges from *Greatly decreased* (-2), *Slightly decreased* (-1), *Same as now* (0), *Slightly increased* (+1), and *Greatly increased* (+2), while the *No opinion* responses have been left out. The values of the organisations were compiled and graphed with standard deviations (see Figure 34).

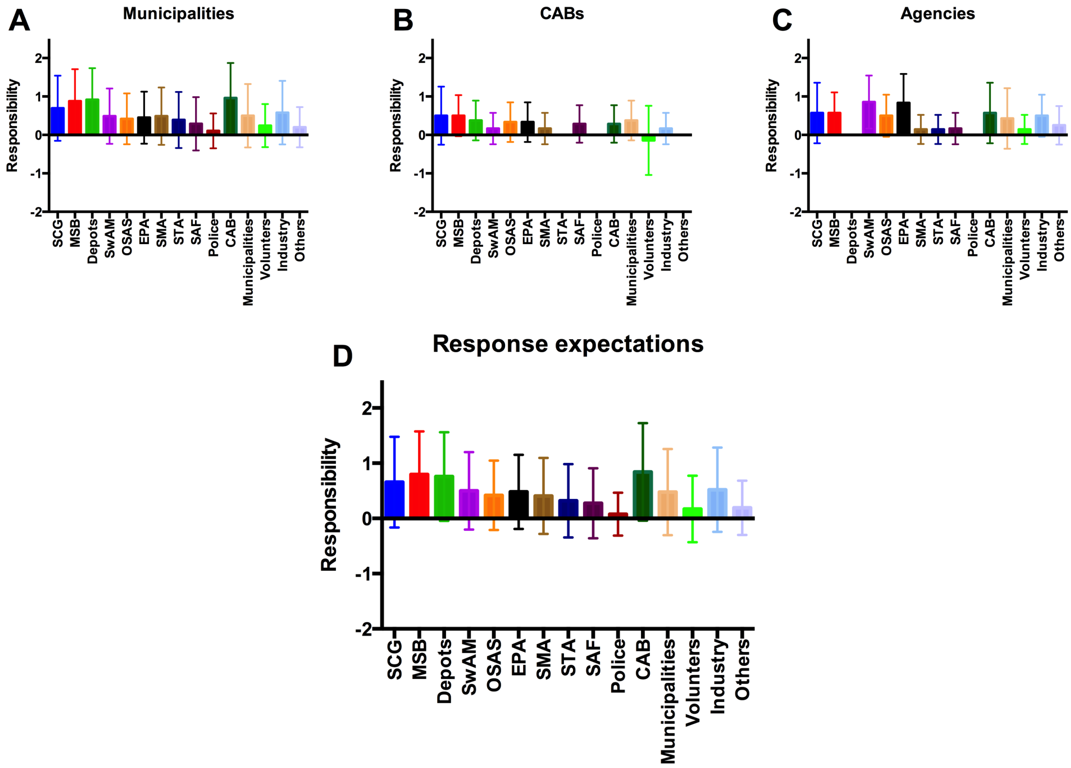

Figure 34: Opinions on what level of responsibility organisations should have for response. Error bars signify standard deviations.

The pattern and thus the opinions of the respondents vary (see Figure 34 A, B and C), with the combined opinions showing that the CABs should have more responsibilities than they have (see Figure 34 D). The opinion of the municipality respondents is that the Depots and CABs should have more responsibility for oil spill response (see Figure 34 A). The CAB respondents are content with the status quo (see Figure 34 B). The agency responders think that SwAM and EPA should have more responsibilities (see Figure 34 C).

5.3.6 Opinion summary

The detailed opinion values for understanding, values, and expectations from the survey can be found in Appendix E - Management Results. The average values can be found below in Table 9.

Table 9: Organisation opinion values from the survey.

Organisation	SCG	MSB	Depots	SwAM	OSAS	EPA	SMA	STA	SAF
Understanding	1.17	0.52	0.82	–0.30	0.31	–0.31	–0.05	–0.39	0.19
Planning values	1.51	1.38	1.30	0.63	0.88	0.37	0.53	0.19	0.05
Response values	1.79	1.35	1.64	0.88	1.45	0.46	0.60	0.28	0.71
Planning expectations	0.74	0.75	0.69	0.55	0.49	0.50	0.41	0.31	0.16
Response expectations	0.66	0.80	0.76	0.50	0.42	0.48	0.41	0.32	0.27

Organisation	Police	CABs	Municipalities	Volunteers	Industry	Others	*Average*	*%*
Understanding	0.06	0.56	0.97	0.17	–0.10	0.00	**0.24**	*56.0*
Planning values	–0.29	1.46	1.69	0.25	0.07	–0.06	**0.66**	*66.6*
Response values	0.22	1.47	1.78	0.73	0.47	0.65	**0.96**	*74.1*
Planning expectations	0.00	0.91	0.55	0.02	0.55	0.10	**0.45**	
Response expectations	0.08	0.84	0.48	0.17	0.52	0.19	**0.46**	

5.4 Discussion

The result of this study has several implications for management and organisation of Swedish oil spill preparedness.

5.4.1 Mandates

Considering that not all of the agencies, CABs, and municipalities agreed that they have responsibilities for oil spill planning and response, there is a need to clarify and communicate their responsibilities. The Tjörn oil spill demonstrated the established practice that SCG and municipalities cooperate in the shallow shoreline areas, even though this is formally a SCG responsibility (MSBHaV, 2014). This is related to the limited draft some of the SCG vessels have, meaning that only the smallest vessels can come all the way up to shore.

5.4.2 Network

The network of connections between the organisations involved in oil spill preparedness is important for cooperation.

5.4.2.1 Planning network

The structure of the planning network reflects the theoretical organisation (see Figure 27), with the main agencies taking a central role (see Figure 28). However, the coordinating "middle management" role of CABs is not evident in the structure. Many municipalities work directly with the agencies as well as with the CABs, rather than exclusively working through the CABs. Few of the municipalities indicated that they work together with their neighbouring municipalities, especially not with municipalities belonging to a separate county. This makes the CABs the most relevant regional link, as is intended.

SwAM occupies an unexpected central role in the networks, considering that the agency does not have a direct mandate for either oil spill planning or response, and its role is unclear to most organisations. OSAS also has a central role in planning, but the decision by SwAM not to renew OSAS's contract, will likely diminish OSAS's importance in the network. The oil spill expertise is retained in Sweco for now (NSO interviews, January 2015). However, if the service is not useful (i.e. generates income), it will likely be disbanded. NSO recognises OSAS as a valuable asset that should be retained and is developing a new structure for supporting oil spill response systems, such as OSAS and the Digital Environmental Atlas (NSO, 2015). The central role of the Depots suggests that municipalities are dependent on them to have oil spill response equipment available. The new locations for the Depots may change the network, depending on how the management of them will develop.

5.4.2.2 Response network

The results show a slightly smaller and denser response network (see Figure 29) compared to the planning network (see Figure 28). This is reasonable, as input from several organisations is needed in order to develop a contingency plan, but all the organisations may not be required during a real oil spill or an exercise. For example, situations may occur when an oil spill does not have an identified polluter. In such situations, SMA and STA are not involved. Similarly, if the spill is small enough that no outside resources are needed for the response, several of the organisations will not be involved at all. The same agencies central for planning are also central to response. However, the influence of SCG, OSAS, and the Depots are higher in the response network than the planning network. The central role of SCG during response was not anticipated, as it does not have any mandate onshore. However, SCG works closely with the municipalities on land, which was evident during the *Fu Shan Hai* (Kustbevakningen, 2013b; Ljungkvist, 2003) and Tjörn oil spills (MSBHaV, 2014). OSAS is a more valued organisation in the response network (see Figure 32), than in the planning network (see Figure 31). Similar to OSAS, the Depots are, and rightly so, a more valuable organisation during the response, particularly for the municipalities (see Figure 32). This reinforces the suggestion that the municipalities rely heavily on the equipment in the Depots to reinforce the municipal response capacity. SwAM remains a central organisation, even if its role is considered to be unclear (see Figure 30). Survey responses show that many municipalities work directly with the agencies. These direct connections speed up communication, but will make the coordinating role of CABs more difficult, if they are not informed of all decisions taken. This suggests that CABs may be better suited to coordinate between the municipalities and neighbouring counties, which is their intended role.

It is notable that the industry is only peripherally involved in these networks. Globally, it is common for a vessel or shipping company to have requirements for an oil spill clean-up company to be on standby. It is also common for the oil companies to have a contingency plan in place, in collaboration with the national resources and the companies' response contractors (IPIECAOGP, 2015; ITOPF, 2012a).

5.4.3 Understanding

It is interesting to note that SCG has a role that the respondents think is much better understood than the other agencies (see Figure 30). However, it is reasonable that the role of the organisations that are directly responsible for oil spill preparedness (SCG, MSB, the Depots, CABs, and the municipalities) are the best understood. This is because they are the primary involved organisations and are working with most of the other organisations on oil spill preparedness (and possibly other issues). Out of the interviewed agencies, SwAM and EPA seem to be particularly unclear to CABs and the agency respondents. SwAM is a relatively new agency in Sweden, having only existed since 2011. The goal of creating SwAM was to create a government agency responsible for coordination and encouragement of aquatic environmental issues and could be tasked with handling national Marine Spatial Planning (MSP) (Hafström, Nilsson, Askman, & Larsson, 2010). The Swedish Board of Fisheries was decommissioned and the largest part of the old agency was combined with the aquatic departments of EPA to create SwAM. From the present research, it is apparent that a number of the respondents believe that some agencies, CABs, and municipalities are unclear about the role and mandate of SwAM concerning oil spill preparedness, even four years after it was created. This lack of familiarity with SwAM is shared with EPA. It is unclear to the respondents what, if any, role the EPA retains in terms of the marine environment in general and oil spills in particular after SwAM was created. However, oiled wildlife was decided to be an EPA responsibility during 2015 (Ericsson, M., telephone communication, January 2016).

OSAS was originally a service contracted by the EPA and tasked with providing expert advice on oil spill issues. However, the responsibility for contracting was transferred to SwAM after its creation and OSAS expanded to include advice on Hazardous and Noxious Substances (HNS). The survey responses indicate that understanding of the role of OSAS is considered low among agencies, CABs, and municipalities (see Figure 30). However, OSAS' expertise has proven to be of great help during real spills (Holmström, Gyllenhammar, Håstad, Fogelberg, & Törneman, 2014; Ljungkvist, 2003; MSBHaV, 2014) and it is mostly present through a representative or consulted via telephone during exercises (Ljungkvist et al., 2013; MSB, 2012; Sjödin, 2011). The low understanding of OSAS' expertise suggests that the service could have been advertised better. However, this is contradicted by the result of the organisational value, which ranks OSAS high for planning (see Figure 31) and even higher for response (see Figure 32). The future of OSAS is uncertain, as its contract was not renewed for 2015 (NSO interviews, 2015). As OSAS have also been assisting several smaller oil spills on land, there is a discussion that the cost should be shared with the EPA or MSB.

5.4.4 Value

The network analysis is reinforced by the value of the different organisations for planning. The same agencies (SCG, MSB, OSAS, and the Depots) stand out as valuable to the respondents (see Figure 31). The municipality and CAB respondents value the same organisations (see Figure 31 A and B), whereas in contrast, the agency respondents value other agencies as highly as CABs and the municipalities (see Figure 31 C).

The same pattern can be seen with the response value, as SCG, OSAS, and the Depots are valued more (see Figure 32). SwAM is, similarly to the network, valued higher for the response than for the planning. In light of the unclear role of SwAM, this was not anticipated and would be interesting to explore further.

The respondents do not consider the industry to be valuable for planning (see Figure 31), but have a role to play during response (see Figure 32). This is often tied to cooperation agreements between some of the industries and the local rescue services.

5.4.5 Expectations

Expectations in this dissertation relates to if the organisations should have greater, lesser, or the same level of responsibilities for oil spill planning and response. The municipality respondents expect CABs to take a greater responsibility in oil spill planning (see Figure 33 A). This opinion is reflected in the draft NSO action plan (NSO, 2015), where CABs are given greater responsibilities by requirements to update their regional oil spill response plans and assess contingency planning at the municipal and regional levels. Since CABs have coordinating responsibility during a response, it is reasonable that they should also have a coordinating responsibility for planning, based on the responsibility and closeness principles. CAB and agency respondents expect more from SwAM and EPA (see Figure 33 B and C). This is also reasonable, as SwAM and EPA are the environmental agencies in Sweden and SwAM is explicitly responsible for following up on environmental issues concerning oil spill planning and response, specifically *Swedish Environmental Objective 10: A Balanced Marine Environment, Flourishing Coastal Areas and Archipelagos* (Environmental Objectives Council, 2006).

The situation is similar in oil spill response, with municipality respondents expecting more help from CABs and the lead agencies (see Figure 34 A). The CAB respondents are content with the response, including the efforts of SwAM and EPA (see Figure 34 B). This might be tied together with low expectations of these agencies, as their role in oil spill preparedness is unclear to many respondents.

5.4.6 Implications

In all of the analyses, SCG stands out as a key organisation. The role of SCG is well understood by the respondents, follows the expectations of the other organisations, is central in the planning and response network, and is highly valuable for both planning and response. This was not anticipated, as the SCG mandate formally does not extend to land and the ability to respond to oil spills once the oil has reached the shore is limited. This central role might be attributed to the fact that SCG is the sole responsible agency for oil spill response at sea and it is the contact point for all such issues. This stands in contrast to the situation on land, where responsibilities are divided between several organisations (see Figure 25). The effectiveness of SCG is attributed to its organisation, resources, and exercises (Kustbevakningen, 2015). Furthermore, SCG has a long history of close collaboration with many of the agencies and organisations on land and has established cooperation channels with other agencies and municipalities.

From the results of the survey, it is evident that SwAM needs to clarify its role in oil spill preparedness and communicate this to the other organisations. The central role of SwAM during planning (see Figure 28) and response (see Figure 29) was not anticipated, in light of the unclear role of the agency.

The industry adoption of the Function-based structure (Curd, 2013; IPIECAOGP, 2014a; OSR, 2013) gives an incentive to move towards this structure for oil spill preparedness. SCG has already established positions harmonised with international coast guard management models, for example the On-Scene Commander (OSC) function. The IMO guidelines (IMO, 1995) specifically mention that (emphasis added):

"It is likely that different agencies or organizations will be responsible for different aspects of the counter-pollution plan, at sea and on shore, but ***overall co-ordination by a designated authority or lead agency is essential for success****."*

Suggesting that the non-hierarchical Team-based structure is not the preferred structure for response according to IMO. Thus, it seems that the maritime sector and industry are moving from the historical Team-based system to the Function-based system, such as IMS.

There are several advantages to standardising IMS: training materials can be shared between organisations; IMS can lower the risk of overlooking important functions during an emergency response, and it replaces the ad-hoc emergency networks with a standardised format that all of the organisations are familiar with (Lindell et al., 2005). A strength of hierarchical structures like IMS is that they are efficient and responsive (Ödlund, 2010). Moynihan (2009) argues that voluntary acceptance and implementation of IMS is the best. A top-down implementation does not work as well and will generate much distrust. However, top-down coordination is hardly possible in a crisis management system (Moynihan, 2009; Ödlund, 2010). Factors such as established routines, clear responsibilities and boundaries, are important for cooperation, while a lack of these factors causes confusion.

Critique against IMS and specifically the Incident Command System (ICS) used in the United States exists, primarily from academics. Waugh Jr. and Streib (2006) argued that centralisation is unrelated or even destructive to the response capacity. Specifically, the criticism has been that ICS ignores the importance of inter-organisational relationships, the spontaneous nature of the response, the role of unorganised volunteers, and the competition between organisations. However, the response community in the United States does not recognise the academic critique and *“has been almost universal in its praise of ICS”* (Buck et al., 2006). Moynihan (2009) gives evidence for three propositions:

- *“Even with centralized network governance, network diversity makes crisis response coordination more difficult.”*
- *“Even with centralized network governance, authority is shared among members and subject to contention, weakening crisis response coordination.”*
- *“Even with centralized network governance, positive working relationships and trust is a critical factor in fostering crisis response coordination.”*

Moynihan (2009) further argues that a consistent group of responders during crisis planning and exercises are crucial to building relationships and trust among them. These relationships are impossible, or at least take time, to build in the middle of a crisis, but are critical for a functioning coordination. Traits, such as mandates, objectives, and forms, influence the culture, identity, and trust of an organisation and vice versa (Ödlund, 2010). Buck et al. (2006) presents evidence that the most important factor for successful use of ICS is pre-established inter-organisational connections. The authors conclude that ICS is just a convenient template to organise around.

Personal contacts and continuity are important factors for successful cooperation and trust needs to be developed over time (Buck et al., 2006; Moynihan, 2009; MSB, 2013a; Ödlund, 2007; Waugh & Streib, 2006). At the same time, there is an inherent trust in specific functions and organisations, in that whoever is there is a capable professional. For these personal connections to emerge, there is a need for more cross-organisational meetings, such as exercises. This may explain the close relationship between the municipalities and SCG, as the SCG have 25 coastal stations and can utilise an extensive network of personal relationships with local organisations and individuals. This focus on interpersonal relationships also extends to the Depots and their surrounding area. Since the Depots have been removed from the local municipality, they may both loose local expertise in handling the equipment and local interpersonal relationships. The other agencies lack these close ties to the municipalities, as they are more centralised.

IMS is considered a good structure for handling multi-organisational operations (IMO, 2012; IPIECAOGP, 2014a). The need for revision of the Swedish model for crisis management during a large response operation has been highlighted by Ödlund (2007), Danielsson et al. (2012), and most recently by Sjökvist (2015). Sjökvist was especially assigned by the Swedish Government to evaluate the large forest fire that occurred in Sweden during summer 2014, and argued that (unofficial translation):

"The management model that works for more mundane emergency response does not work during larger incidents. During the fire it became clear that in these extreme cases, a management model that all key stakeholders are aware of, and able to work through, is required."

Indeed, ICS originated in the problems with complex multi-agency emergency management from forest fires in California in the 1970s and was only later adopted for oil spill response, formally in 2004 (Buck et al., 2006; Jamieson, 2005; Lindell et al., 2005).

The weaker link between the different counties, compared to the municipalities within the counties, suggests that the existing Team-based structure works up to the county level. When the response involves more than one county, there is likely a need for a Function-based structure, such as IMS. However, a Function-based structure may be needed even at the municipal level in certain areas. If the interpersonal relationships do not exist between two municipalities, as indicated in the networks, there is likely a need for a Function-based structure even at this level. Consequently, cross-organisational exercises are needed in order to build these personal relationships and understanding for other organisations. These exercises are essential in order to properly evaluate the need for a Function-based structure.

The scores of the variables for the management of oil spill preparedness analysed in this chapter have been summarised in Table 10 below.

Table 10: Scores for the units of analysis.

	Preferable	*Sufficient*	*Insufficient*	Score
Mandates	95% or more of the governmental organisations have oil spill responsibilities in their mandate.	From 50% up to 95% of the governmental organisations have oil spill responsibilities in their mandate.	Less than 50% of the governmental organisations have oil spill responsibilities in their mandate.	**70%**
Planning network density	95% or more of the maximum possible planning connections between the agencies, CABs, and municipalities.	50% up to 95% of the maximum possible planning connections between the agencies, CABs, and municipalities.	Less than 50% of the maximum possible planning connections between the agencies, CABs, and municipalities.	**82.8%**
Response network density	95% or more of the maximum possible response connections between the agencies, CABs, and municipalities.	50% up to 95% of the maximum possible response connections between the agencies, CABs, and municipalities.	Less than 50% of the maximum possible response connections between the agencies, CABs, and municipalities.	**88.3%**
Responses for understanding	Respondents consider organisational roles well understood, 95% or more of the maximum score.	Respondents consider organisational roles understandable, from 50% up to 95% of the maximum score.	Respondents do not consider organisational roles understandable, less than 50% of the maximum score.	**56.0 %**
Responses for planning values	Respondents consider most existing organisations valuable for planning, 95% or more of the maximum score.	Respondents consider existing organisations valuable for planning, from 50% up to 95% of the maximum score.	Respondents consider most existing organisations not valuable for planning, less than 50% of the maximum score.	**66.6 %**
Responses for response values	Respondents consider most existing organisations valuable for response, 95% or more of the maximum score.	Respondents consider existing organisations valuable for response, from 50% up to 95% of the maximum score.	Respondents consider most existing organisations not valuable for response, less than 50% of the maximum score.	**74.1 %**
Responses for planning expectations	Respondents consider organisational responsibilities for planning to meet expectations, average score up to +/- 0.25.	Respondents consider organisational responsibilities for planning to be close to expectations, average score from +/- 0.25 to 1.0.	Respondents do not consider organisational responsibilities for planning to meet expectations, average score below -1.0 or over 1.0.	**0.45**

Responses for response expectations	Respondents consider organisational responsibilities for response to meet expectations, average score up to +/- 0.25.	Respondents consider organisational responsibilities for response to be close to expectations, average score from +/- 0.25 to 1.0.	Respondents do not consider organisational responsibilities for response to meet expectations, average score below -1.0 or over 1.0.	**0.46**

As shown by the analysis of the variables in Table 10 and the overall *Sufficient* ranking, indicating that the Swedish oil spill preparedness management structure is generally understood by the involved organisations, follows a logical division of responsibilities, and has an established network, the hypothesis:

H1 – The preparedness regime is effectively managed

is accepted and the null hypothesis $H1_0$ is rejected. Even though there are several deficiencies in the network, the system seems to be functioning. However, this does not mean that it will work during a larger oil spill and the structure still needs to be exercised more frequently (as discussed in Chapter 8), in order to function according to expectations.

5.4.7 Limitations

The focus of the hypothesis is directed towards the rationalist perspective and omits the social psychological perspective due to time constraint.

Not all agencies that have been commented on have had a chance to respond. The reason for this is that they were not part of the National Cooperation Group for Oil Combating (NSO), or do not have any formal responsibilities for oil spill preparedness. This negative bias is negated by the duality of a relationship, in that both connections can claim to be connected to the other. Thus, a connection exists if one of the organisations claims to be connected to another, even if only one of them responds. Similarly, additional responses from municipalities and CABs might have impacted the responses further, although the high response rate suggests that the effect would be minor.

5.5 Conclusion

The most efficient strategy to handle an oil spill at sea is always to prevent the spill from reaching the coastline and respond to it before it comes ashore. However, as this is might not be effective enough, the onshore organisations need to cooperate with each other and with the organisations at sea.

The Swedish oil spill management system follows an established structure and is generally understood by those involved. The most trusted and valued organisation is the Swedish Coast Guard, even though it has no response operations or mandates onshore. The Swedish Agency for Marine and Water Management also stands out, as most survey respondents consider the role of the agency to be unclear. This may be because other organisations are still unsure of the separation between the responsibilities of this relatively new agency and the Environmental Protection Agency. Before the Tjörn oil spill and subsequent evaluation, the representatives from the Swedish Agency for Marine and Water Management were not familiar with the role of the agency in the oil spill management network or the expectations of other organisations. It is surprising that this agency occupies such a central role in the planning and response networks, considering that it has no direct mandate for either and the role of the agency is viewed as unclear. The network analysis additionally shows that both the Oil Spill Depots and the Oil Spill Advisory Service are important, which makes their future existence and relocation a critical issue for Swedish oil spill preparedness. This is recognised by the National Cooperation Group for Oil Combating in its current draft action plan, but no agency is so far willing to take responsibility for the Oil Spill Advisory Service.

The Swedish Team-based structure for response could benefit from harmonising some of the common positions in the organisations. The management system itself has not been tested during a response to an accident larger than 1,200 tonnes. The few connections between the counties, and in some cases between neighbouring municipalities, in the oil spill preparedness network suggests a need to implement a

Function-based system for large cross-organisational operations on a national level, for example large oil spills. Thus, there is a need to conduct more cross-organisational exercises in order to build the interpersonal relationships and understanding of other organisation involved in oil spill preparedness and to evaluate the need for a Function-based structure in Sweden.

Chapter 6 - Prevention

The second of the five results chapters focuses on the oil spill preparedness topic of prevention and specifically the Swedish political commitment to, and the Government's implementation of, international conventions related to oil spill prevention and response. It also examines Swedish involvement in existing international cooperation agreements.

6.1 Introduction

Oil spill prevention is defined to mean mitigating measures on a national or international level. These are preparedness measures set in place before an accident occurs, to minimise the accident risk and negative impacts of a spill. These measures are collectively called international regulations and consist of international conventions and agreements, industry standards, and European Union (EU) legislation. It can be argued that preparedness, rather than prevention, is a better term for the examination of the aforementioned regulations, as many of these specifically govern either response or prevention measures. However, this chapter focuses on the Swedish Government's work on implementation of international regulations into the national context. Implementation of international regulations is considered a proactive prevention measure, affecting Swedish oil spill preparedness. Improved oil spill preparedness in the form of these preventive measures, means that impacts are mitigated and consequently costs are lowered for oil spills (Knapp & Franses, 2009; Knudsen & Hassler, 2011). Contingency plans, training, and equipment are discussed in Chapters 7 and 8.

Governmental support is critical to the process of encouraging or discouraging prevention activities (Tierney, 1993; Veiga & Wonham, 2002). The government who ratifies international conventions and signs agreements should institute laws that see them incorporated into national legislation, designate responsible agencies, and provide these agencies with sufficient budget to implement the assigned tasks.

However, the ratification of international conventions relate to a number of different obstacles, usually tied to the implementation of the convention. For example, conventions by the International Maritime Organization (IMO) usually have a significant effect on the flag and consequently fleet of the Parties to these conventions. Holt (1993) maintained that IMO suffers from the Lowest Common Denominator (LCD) effect through the consensus process, where one or a few States can stall the work of a majority consensus. Hassler (2008) identified deficiencies in implementation of both IMO Conventions and the Helsinki Convention in the Baltic Sea. Knudsen and Hassler (2011) disagree with Holt and instead highlight IMO's openness to change and readiness to respond to public pressure, but is critical of the weak link between IMO and national administrations. They argue that the effect of interpretation and available resources makes the implementation differ. One problem relating to international shipping is that Flag States are often developing countries with weaker regulations and enforcement than developed countries, including on environmental regulations (Knudsen & Hassler, 2011).

Sweden has a long history of working proactively with environmental issues. For example, Sweden initiated the first United Nations (UN) Conference on the Human Environment, that convened in Stockholm 1972 (Johnson, 2012; UN, 1968) and was deeply engaged in the formulation of the 1974 Helsinki Convention, the establishment of HELCOM in 1974, in the 1992 revision of the Helsinki Convention, its Baltic Sea Joint Comprehensive Environmental Action Programme, and its Baltic Sea Action plan (Hassler, 2003; HELCOM, 2007a; 2008). The Swedish Government stated in October 2005 (Regeringen, 2005b):

"[The Swedish] government will endeavour to make all Nordic EU members strive for the EU Marine Strategy to become as potent as possible".

The Swedish Government has assigned the Swedish Agency for Water and Marine Management (SwAM) to be responsible for the environmental quality objective *"A*

Balanced Marine Environment, Flourishing Coastal Areas and Archipelagos", which originally includes the specific *Interim target 7: Discharges of oil and chemicals* (Environmental Objectives Council, 2006). This target stated that:

"By 2010 discharges of oil and chemicals from ships will be minimized and reduced to a negligible level by stricter legislation and increased monitoring."

Interim Target 7 was reported to have been achieved by 2010 (Naturvårdsverket, 2011), when all Interim Targets where removed and incorporated into the general Environmental Objectives. However, the justification for the removal was not elaborated. Curiously, oil spills are still mentioned to be a problem in the most recent evaluation of the Environmental Objectives (Naturvårdsverket, 2015).

Concerning IMO regulations, Sweden led the suggestion to classify the Baltic Sea as a Particularly Sensitive Sea Area (PSSA) in January 2004 (Hassler, 2008; Knudsen & Hassler, 2011). PSSA is a type of area protection assigned by IMO. Subsequently, all Baltic Sea region countries except Russia endorsed this proposal, and PSSA status for the Baltic Sea was obtained in April 2004 (Knudsen & Hassler, 2011; Lindén, Chircop, Pourzanjani, Schröder-Hinrichs, & Raaymakers, 2006; Pålsson, 2008). Russia chose to not sign the agreement, which means that the Russian Baltic Sea waters are exempted from the PSSA status. In contrast, Sweden wanted even stricter limitations on the shipping in the Baltic Sea (Regeringen, 2005b). Sweden is also active in the Expert Working Groups HELCOM RESPONSE (concerning oil spill response), and the HELCOM SHORE (concerning onshore oil spill response), by chairing the first and coordinating the latter (NSO interviews, January 2015). Sweden is also active in the North Sea through OSPAR and the Bonn Agreement (Kustbevakningen, 2015).

Taking these examples into account, it is clear that Sweden has historically expressed a considerable ambition to improve the environment globally and regionally, both concerning environmental issues in general and oil spill preparedness specifically. This chapter shows that the Swedish political commitment to oil spill preparedness is in good standing, but has some shortcomings. However, it is of course possible to want to protect the marine environment while simultaneously scaling down oil spill preparedness. But maintaining existing preparedness is considered to be cheaper and more effective than rebuilding it (ITOPF, 2011b; Veiga & Wonham, 2002).

6.2 Methods

Chapter 6 includes an analysis of the Swedish Government's commitment to oil spill prevention. The analysis examined ratification and implementation of international conventions as a way of estimating the political commitment to oil spill prevention.

6.2.1 Study design

The research question is formulated as Hypothesis 2, H2.

H2 – Political commitment is sufficient

Which gives the null hypothesis:

$H2_0$ – Political commitment is insufficient

Hypothesis 2 was chosen to analyse whether the political commitment to oil spill prevention is sufficient. The units of analysis have been chosen based on reasoning and practicality after consulting literature and expert opinions.

Which international conventions are ratified and implemented, and which international agreements are signed and implemented determine the political commitment. Additionally, the budget to the responsible agencies and authorities determine if the government has allocated sufficient funds for the implementation. The relationship between the units of analysis and their corresponding variables can be seen in Figure 35.

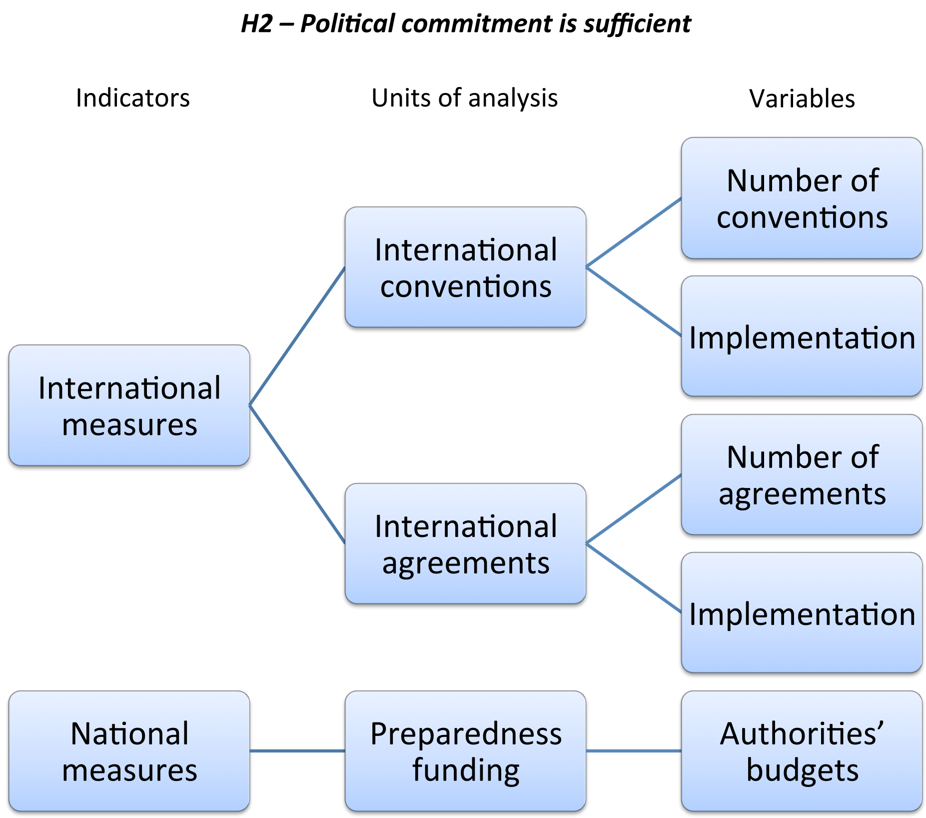

Figure 35: Hypothesis 2 chosen indicator, units of analysis, and variables.

For oil spill preparedness to be considered to have political commitment, the relevant international conventions and agreements should be ratified or signed, and demonstrate that they have been implemented and budgeted for. Only international conventions and agreements relating specifically to pollution by oil from ships or offshore activities have been considered. The focus of this study is on impacts exclusive to Sweden. Requirements relating to the ships themselves have therefore been excluded, although it is recognised that provisions for increased safety onboard has an impact on the ship as a whole and the risk of having an accident. H2 excludes the inherent value and impact of the different international conventions and agreements, as a discussion on a single convention and its implementation is by itself substantial enough to be the topic of a PhD.

These criteria have been quantified in Table 11, following to the reasoning for ranking the variables in Chapter 4.

Table 11: Evaluation criteria for H2.

	Preferable	*Sufficient*	*Insufficient*
Number of conventions	95% or more of the 11 relevant international conventions ratified.	From 50% up to 95% of the 11 relevant international conventions ratified.	Less than 50% of the 11 relevant international conventions ratified.
Conventions implemented	95% or more of the 11 relevant international conventions implemented.	From 50% up to 95% of the 11 relevant international conventions implemented.	Less than 50% of the 11 relevant international conventions implemented.
Number of agreements	95% or more of the 4 relevant international agreements signed.	From 50% up to 95% of the 4 relevant international agreements signed.	Less than 50% of the 4 relevant international agreements signed.
Agreements implemented	95% or more of the relevant international agreements implemented.	From 50% up to 95% of the relevant international agreements implemented.	Less than 50% of the relevant international agreements implemented.
Preparedness funding	Funding for preparedness measures and agencies is increased by more than 5% from 2010 to 2015.	Funding for preparedness measures and agencies is stable and does not deviate more than +/- 5% from 2010 to 2015.	Funding for preparedness measures and agencies is decreased by more than 5% from 2010 to 2015.

These levels correspond to if a variable is wholly present and/or functioning (*Preferable*), partially present and/or functioning (*Sufficient*), or not present and/or functioning at all (*Insufficient*). All of the units of analysis will have to demonstrate that they at least reach the rank of *Sufficient* for H2 to be accepted, meaning that the oil spill prevention measures are sufficient, but should be further developed. If all variables are ranked *Preferable*, oil spill prevention measures are at the best practice level. If any of the variables are ranked *Insufficient*, important oil spill prevention measures are missing, negatively impacting Swedish oil spill preparedness.

6.2.2 Sources

Convention data and texts were collected from publicly available sources, primarily government and convention websites. Scientific papers have been gathered through the library at the World Maritime University (WMU) and open access journals online. Project reports have been gathered from the project pages of various oil spill projects.

Additional information and comments have been gathered from the questionnaire (see Appendix A - Questionnaire) distributed to all Swedish coastal municipalities and County Administrative Boards (CABs), and the interviews (see Appendix B - Interview) with the members of the National Cooperation Group for Oil Combating (NSO), described in Chapter 4.

6.2.3 Analysis

The provisions of the relevant international conventions and agreements have been analysed systematically and the implementation has been evaluated. Additionally, the national budgets for the principal agencies responsible for oil spill preparedness have been examined.

6.3 Results

Sweden is party to two main types of international regulations: international conventions and international agreements. As Sweden is a member of the EU, the relevant EU Directives are also addressed. The funding available for preparedness is reflected in the budget for the responsible agencies.

6.3.1 International conventions

International conventions relating to pollution of oil from ships are primarily governed by IMO, with the exception of United Nations Convention on the Law of the Sea (UNCLOS) that is governed by the United Nations (UN) General Assembly.

6.3.1.1 UNCLOS

The United Nations Convention on the Law of the Sea (UNCLOS) was adopted 10 December 1982. UNCLOS is the most important legal instrument for the oceans (UN, 2001). It entered into force 16 November 1994 and as of 10 October 2014, 166 states have ratified this convention (UN, 2014). Sweden ratified it 25 June 1996 (UN, 2014). UNCLOS establishes extensive guidelines for businesses, environment, and management of marine natural resources. However, only a few of the provisions in UNCLOS refer to pollution by discharges of oil and other substances. These issues requires Parties to the convention to establish national regulations to prevent, reduce, and control pollution of the marine environment from vessels (Article 211), regulate enforcement by Flag States (Article 217), inspections and enforcement by Port States (Article 218 and 219); enforcement by Coastal States (Article 220 and 221), and pursue offenders (Article 111). None of the articles relate specifically to oil spill preparedness.

6.3.2 IMO Conventions

The many IMO Conventions are key to the international prevention measures for oil pollution by ships. IMO establishes common regulations for oil spills from ships, and installing prevention measures in the form of design requirements and risk reduction measures (Schröder-Hinrichs & Hebbar, 2006). The conventions specifically relating to oil pollution from ships or offshore activities are listed in Table 12. Denounced signifies that a state has withdrawn its ratification, in this case because the updated replacement conventions have made the original conventions obsolete.

Table 12: IMO Conventions relating to pollution by oil from ships or offshore activities ratified and denounced by Sweden (ECOLEX, 2015a; 2015b; FAO, IUCN, UNEP, n.d.; IMO, 2015a; 2015c).

Convention	IMO Adoption	Swedish ratification/accession	Entry into Force	Status
MARPOL 73/78 (Annex I/II)	1973-11-02	1980-06-09	1983-10-02	Ratified
MARPOL 73/78 (Annex III)	1973-11-02	1980-06-09	1992-07-01	Ratified
MARPOL 73/78 (Annex IV)	1973-11-02	1980-06-09	2003-09-27	Ratified
MARPOL 73/78 (Annex V)	1973-11-02	1980-06-09	1988-12-31	Ratified
MARPOL Protocol 97 (Annex VI)	1997-09-26	1998-05-18	2005-05-19	Ratified
INTERVENTION Convention 69	1969-11-29	1973-02-08	1975-05-06	Ratified
INTERVENTION Protocol 73	1973-11-02	1976-06-28	1983-03-30	Ratified
CLC Convention 69	1969-11-29	1975-03-17	1975-06-19	Denounced
CLC Protocol 76	1976-11-19	1978-07-07	1981-04-08	Ratified
CLC Protocol 92	1992-11-27	1995-05-25	1996-05-30	Ratified
FUND Convention 71	1971-12-18		1978-09-16	Denounced
FUND Protocol 76	1976-11-19	1978-07-07	1994-11-22	Ratified
FUND Protocol 92	1992-11-27	1995-05-25	1996-05-30	Ratified
FUND Protocol 2003	2003-05-16	2005-05-05	2005-08-05	Ratified
OPRC Convention 90	1990-11-30	1992-03-30	1995-05-13	Ratified
BUNKER Convention 01	2001-03-23	2013-06-03	2008-11-21	Ratified

Table 12 shows that Sweden has ratified the relevant IMO Conventions (ECOLEX, 2015a; 2015b; FAO et al., n.d.; IMO, 2015a; 2015c). However, the OPRC Convention is of particular interest as a prevention measure to national oil spill preparedness, since it has provisions that are not exclusive to ships. Additionally, the CLC Convention and the FUND Convention are indirectly important for prevention. But as these liability conventions are primarily handled by an international secretariat, they do not require much implementation and have not been considered for further analysis.

6.3.2.1 MARPOL

The 1973 International Convention for the Prevention of Pollution from Ships (MARPOL) was originally adopted on 2 November 1973 and modified by the 1978 Protocol (IMO, 1978; 2015b). The 1978 Protocol came about after a series of tanker accidents between 1976 and 1977, but since the 1973 Convention had not yet entered into force, the 1978 Protocol absorbed the 1973 Convention and both entered into force on 2 October 1983. MARPOL has been updated by several amendments and additions since entering into force. It is the main international convention that regulates the prevention of pollution of the marine environment by ships. MARPOL includes six technical Annexes relating to different kinds of pollution (IMO, 2015b):

- Annex I Regulations for the Prevention of Pollution by Oil entered into force 2 October 1983.
- Annex II Regulations for the Control of Pollution by Noxious Liquid Substances in Bulk entered into force 2 October 1983.
- Annex III Regulations for the Prevention of Pollution by Harmful Substances Carried by Sea in Packaged Form entered into force 1 July 1992.
- Annex IV Regulations for the Prevention of Pollution by Sewage from Ships entered into force 27 September 2003.
- Annex V Regulations for the Prevention of Pollution by Garbage from Ships entered into force 31 December 1988.
- Annex VI Regulations for the Prevention of Air Pollution from Ships entered into force 19 May 2005.

Since this study is limited to oil spills, only Annex I is of relevance.

Annex I

Annexes I and II have been ratified by 152 states (EMSA, 2012), which represents 99.2% of the world's shipping tonnage. This makes MARPOL one of the most successfully implemented conventions. It requires all ships to be fitted with oil pollution prevention equipment. It has clear rules of how and under which circumstances oil and oily mixture may be discharged from the ship via bilge water and from tanks, for example maximum concentration and distance to land. Regulation 37 further requires tankers of more than 150 gross tonnage (gt) and vessels of more than 400 gt, to have a Shipboard Oil Pollution Emergency Plan (SOPEP) onboard, which is approved by the Flag State. If any pollution in or around the vessel is observed, the ship's master should be made aware immediately and respond appropriately, as detailed in the SOPEP. However, simultaneous threats against the life or safety of the crew have priority. MARPOL Annex I does not contain any other requirements for national oil spill prevention measures.

6.3.2.2 Intervention Convention

The International Convention Relating to Intervention on the High Seas in Cases of Oil Pollution Casualties (Intervention Convention) was adopted on 29 November 1969 and entered into force on 6 May 1975 (UN, 1969). It regulates if, and what, measures Coastal States may take on the High Seas (meaning the areas beyond national jurisdiction) to prevent, mitigate or eliminate any danger from oil pollution to the coastline or other interests, after a maritime accident. However, the Coastal State is only allowed to take necessary actions and must consult with the Flag State or States of the ships involved, the owners of ship and cargo, and possibly independent experts. If a Coastal State takes action beyond allowed limits, it is liable to pay compensation for any damage caused by its actions. None of these actions involve measures on the shore, with the possible exception of emergency towing procedures to a place of refuge.

6.3.2.3 OPRC Convention

Sweden signed the International Convention on Oil Pollution Preparedness, Response and Co-operation (OPRC Convention) on 30 March 1992 and it entered into force on 13 May 1995 (ECOLEX, 2015b). It is the largest international agreement on oil spill response cooperation, with 109 signatory states as of 27 February 2015 (ECOLEX, 2015b). The individual articles in the OPRC Convention were analysed and indicators for their implementation were investigated (see Table 13). In summary, only Articles 4 to 10 are relevant for implementation by the Swedish Government, as the other articles concern convention explanation and procedures.

Table 13: Analysis of the OPRC Convention articles.

Articles	Description	Explanation	Implemented
Article 1 **General provisions**	Sets out rules and limitations of the convention.	Explanatory text.	Not applicable
Article 2 **Definitions**	Defines keywords used in the convention.	Explanatory text.	Not applicable
Article 3 **Oil pollution emergency plans**	Requirements for ships, offshore units and seaports to have an onboard oil pollution emergency plan.	Only relates to ships.	Not applicable
Article 4 **Oil pollution reporting procedures**	Requirements for ships, offshore units, seaports and aviation to without delay report any oil spill pollution observed to the relevant coastal State.	Enforced by the relevant actors themselves, SCG aerial surveillance, and EMSA satellite surveillance.	Yes
Article 5 **Action on receiving a pollution report**	Requirements for Parties to assess the spill and inform other Parties at risk of any oil spills that has been reported.	Responsibility of SCG as responsible authority for the convention.	Yes
Article 6 **National and regional systems for preparedness and response**	Requirements to designate a national responsible authority and contact point and a national contingency plan; establish a minimum level of oil spill combating equipment, an exercise programme, and communication capabilities.	All points established at sea. No points completely established on land. Varies between municipalities and no clear responsible authority. No national contingency plan.	Partially
Article 7 **International cooperation in pollution response**	Requirements to cooperate between Parties if needed and establish measures to facilitate this cooperation.	Cooperation exercises and project participation.	Yes
Article 8 **Research and development**	Requirements to cooperate between Parties to promote and exchange results of research and development.	Cooperation exercises and project participation.	Yes
Article 9 **Technical cooperation**	Requirements to cooperate between Parties to train personnel, ensure availability of resources, and initiate joint research and development programmes.	Cooperation exercises and project participation.	Yes
Article 10 **Promotion of bilateral and multilateral**	Requirement to promote cooperation agreements.	Cooperation exercises and projects.	Yes

cooperation in preparedness and response			
Article 11 Relation to other conventions and international agreements	Establishes that this convention should not work against other conventions.	Explanatory text	Not applicable
Article 12 Institutional arrangements	Designation of coordinator to handle information services, education and training, and technical services.	IMO designated as coordinator.	Not applicable
Article 13 Evaluation of the convention	Requirement to evaluate the effectiveness of the convention	IMO designated as evaluator.	Not applicable
Article 14 Amendments	Procedure explanation.	Explanatory text	Not applicable
Article 15 Signatures, ratification, acceptance, approval and accession	Procedure explanation.	Explanatory text	Not applicable
Article 16 Entry into force	Procedure explanation.	Explanatory text	Not applicable
Article 17 Denunciation	Procedure explanation.	Explanatory text	Not applicable
Article 18 Depository	Procedure explanation.	Explanatory text	Not applicable
Article 19 Languages	Procedure explanation.	Explanatory text	Not applicable
Annex Reimbursement of costs of assistance	Procedure explanation.	Explanatory text	Not applicable

Articles 4 to 5

Article 4 establishes requirements for ships, offshore units, seaports, and aviation to report any oil spill pollution observed to the relevant Coastal State without delay. Article 5 establishes requirements for Parties to assess the oil spill and inform other Parties at risk of any reported oil spills.

The Swedish Coast Guard (SCG) has addressed issues relating to the oil pollution reporting procedures, as they receive and respond to reports of oil spills (Regeringen, 2007c).

For aerial observations of oil spills, in addition to publically reported observations, SCG employs their own fleet of three surveillance aircraft that run daily patrols along the entire Swedish coastline (HELCOM, 2014c; Kustbevakningen, 2014). SCG reported 2,283 flight hours to HELCOM in 2013, corresponding to more than half of the total reported hours (HELCOM, 2014c). Additional visual observations are supplied from EMSA satellite images (EMSA, 2013a; 2013b).

Article 6

Article 6 establishes requirements to designate a national responsible authority and contact point and a National Contingency Plan (NCP), establish a minimum level of oil spill response equipment, an exercise programme, and communication capabilities.

At sea, oil spill preparedness has a clear structure, with SCG the designated responsible authority and contact point, as discussed in Chapter 5. This is explicitly mentioned in the SCG instructions from the Swedish Government (Regeringen, 2007c; 2014d). SCG has established oil spill combatting equipment on their vessels and in ports, conduct frequent exercises, and have interorganisational communication capabilities. On land, this is not as clear. Since SCG is only responsible for oil spills at sea and in the great lakes, Vänern, Vättern, and Mälaren (Sveriges Riksdag, 2003), the role of the agency as the sole responsible authority is only partly true. No document titled National Contingency Plan has existed for Sweden according to the senior experts (Evans, S., telephone communication, October 2014 and NSO interviews, January 2015).

Article 7 to 9

Articles 7 to 9 requires Parties to cooperate if needed and establish measures to facilitate this cooperation: to promote and exchange results of research and development, to train personnel, ensure availability of resources, and initiate joint research and development programmes.

These are all addressed in the instructions to SCG (Regeringen, 2007c) and to the Swedish Civil Contingencies Agency (MSB), the agency responsible for disaster preparedness and management (Regeringen, 2008b). Additionally, Articles 7 to 9 have been implemented through a number of EU projects, for example measures to facilitate cooperation (Forsman, 2012b) and training (Sjöfartsverket, 2005). However, the convention text does not mentioned to what extent this facilitation is required, and it could be debated if any country has done enough to facilitate cooperation, and promote and exchange results.

Article 10

Article 10 establishes the requirement to promote cooperation agreements.

This has been addressed through the regular cooperation exercises that SCG takes part in or organise (Kustbevakningen, 2011; 2012; 2013a; 2014), and through working in EU projects, for example agreement development in the BRISK project (BRISK, 2012).

6.3.2.4 CLC Convention

The 1969 International Convention on Civil Liability for Oil Pollution Damage (CLC Convention), was adopted on 29 November 1969 and entered into force on 19 June 1975 (IOPC Funds, 2011). It was replaced by the 1992 Civil Liability Convention, which was adopted on 27 November 1992 and entered into force on 30 May 1996. The CLC Convention gives shipowners a strict liability for pollution damage caused by oil leaks or discharges from their ships into any territories belonging to a Party of the convention. Strict liability means that the shipowner is liable even if not at fault for the oil pollution, with a few exceptions. The CLC Convention applies to ships carrying oil as cargo and does not include spills of fuel oil from other ships. It was adopted to make sure that adequate compensation is available to countries and individuals who suffer oil pollution damage from oil tankers. The CLC Convention relates to oil spill prevention through establishing a system for claims for response costs and damage. The convention does not require much in terms of implementation by the national governments, as it is run by an international secretariat.

6.3.2.5 FUND Convention

The 1971 International Convention on the Establishment of an International Fund for Compensation for Oil Pollution Damage (FUND Convention), was adopted on 18 December 1971 and entered into force 16 October 1982 (IOPC Funds, 2011). It was replaced by the 1992 Protocol, which was adopted on 27 November 1992 and entered into force on 30 May 1996, at the same time as the CLC Convention. The FUND Convention was established to create an international fund to relieve the shipowners of the financial burden of the CLC Convention, and to provide additional compensation to the victims in cases where the CLC Convention was inadequate or unobtainable. Victims of oil spill pollution damage can thus be compensated beyond the shipowner's liability, and in situations where there is no shipowner liable. To this end, the FUND Convention established the separate 1992 International Oil Pollution Compensation Fund, known as the IOPC Fund (IOPC Funds, 2011). The IOPC Fund is not a UN agency, but is an intergovernmental organisation following procedures similar to those of the UN. Only States can become members of the IOPC Fund. The FUND Convention relates to oil spill prevention through establishing a system for claims for response costs and damage claims. The convention does not require much in terms of implementation by the national governments, as it is run by an international secretariat.

6.3.2.6 Bunker Convention

The International Convention on Civil Liability for Bunker Oil Pollution Damage (Bunker Convention) was adopted on 23 March 2001 and entered into force on 21 November 2008 (IMO, 2001; Jacobsson, 2009). The convention was adopted to fill the gap from the CLC Convention and the FUND Convention, by providing compensation for oil spill pollution damage when oil is carried as bunker fuel, and not cargo. The Bunker Convention only covers pollution damage in the territorial seas and Exclusive Economic Zones (EEZ) of the Parties, and is modelled on the CLC Convention. Similar to the CLC Convention, a key requirement of the Bunker Convention is the need for the shipowners to maintain compulsory insurance. Another key provision is the requirement for direct action, which would allow a compensation claim to be brought directly against an insurer. However, contrary to the CLC Convention, it is not supported by any fund.

6.3.3 International agreements

Sweden is active in many international and regional agreements. For example, SCG regularly represents Sweden at meetings and in the various exercises, thus performing relevant commitments to these agreements (Kustbevakningen, 2011; 2012; 2013a; 2014). Of the examined agreements, only HELCOM contains a measure comparable to the OPRC Convention, in mentioning a National Contingency Plan for oil spills.

6.3.3.1 Arctic Agreement

The Arctic Council Member States: Canada, Denmark, Finland, Iceland, Norway, Russia, Sweden, and the United States, signed the Agreement on Cooperation on Marine Oil Pollution Preparedness and Response in the Arctic on 15 May 2013 (Arctic Council, 2013). As of February 2014, Norway, Finland, Russia, and Canada have completed internal procedures for entry into force (Arctic Council, 2014). Sweden and Finland are unique in that they do not have a coast towards the Arctic sea directly. However, the northern parts of the Baltic Sea are well within any definition of the Arctic and share many of the issues with the Arctic areas outside of the Baltic Sea. The aim of the Arctic Agreement is to protect the Arctic marine environment from pollution by oil, through strengthening cooperation, coordination, and mutual assistance among the Parties. The content of the agreement is similar to the OPRC Convention. Additionally, the agreement describes the development of Operational Guidelines, yet to be written, which will include notification procedures, requests for assistance, coordination and cooperation procedures, transboundary movement of resources, joint exercises, and reimbursement procedures.

The Arctic agreement is worded similarly to the OPRC Convention, but a notable exception is that Article 4:1 (emphasis added) requires that:

"Each Party shall maintain a national system for responding promptly and effectively to oil pollution incidents. This system shall take into account particular activities and locales most likely to give rise to or suffer an oil pollution incident and anticipated risks to areas of special ecological significance, and shall include at a ***minimum a National Contingency Plan or plans for preparedness and response to oil pollution incidents****."*

Unlike the OPRC Convention, there is no requirement to have a National Contingency Plan, if other plans for preparedness and response exist.

6.3.3.2 Bonn Agreement

The Agreement for cooperation in dealing with pollution of the North Sea by oil and other harmful substances is known as the Bonn Agreement (Bonn Agreement, 1983). It was agreed by Belgium, Denmark, France, Germany, Netherlands, Norway, Sweden, and the United Kingdom in 1969, in the wake of the *Torrey Canyon* oil spill (Bonn Agreement, 2015). The EU joined the agreement in 1983 and Ireland in 2007, and it now covers a large geographic area around the Bonn Agreement Member States. The aim of this agreement is to cooperate on oil spill response and oil spill surveillance. To accomplish this, several documents have been produced, for example the Counter-Pollution Manual (Bonn Agreement, 2014) and Aerial Operations Handbook (Bonn Agreement, 2009), and annual exercises called BONNEX are held. The Bonn Agreement does not include any provisions for National Contingency Planning or other measures onshore.

6.3.3.3 Copenhagen Agreement

The Nordic Agreement on Cooperation regarding Pollution at Sea from Oil and Other Substances is known as the Copenhagen Agreement (Københavnsavtalet, 2004). It was agreed by Denmark, Iceland, Norway, Finland, and Sweden in 1971 and amended in 1993. The aim of the Copenhagen Agreement is to cooperate in protecting the marine environment through monitoring, investigation, reporting, evidence collection, pollution control, assistance, and information exchange. Parties also cooperate in preparation guidelines and through regular exercises (Københavnsavtalet, 2015b). The Copenhagen Agreement does not make any provisions for contingency planning, but has a guide (Københavnsavtalet, 2015b) that is otherwise detailed regarding response cooperation and exercises at sea. Onshore activities have been included in the Copenhagen Agreement exercises a few times, for example in Gothenburg 2010 (Københavnsavtalet, 2010).

6.3.3.4 HELCOM

The Convention on the Protection of the Marine Environment of the Baltic Sea Area, known as the Helsinki Convention 1974, was signed by Denmark, Finland, West Germany, East Germany, Poland, USSR, and Sweden in 1974 and entered into force on 3 May 1980. It was replaced by the Convention on the Protection of the Marine Environment of the Baltic Sea Area, known as the Helsinki Convention 1992, which was signed by Czechoslovakia, Denmark, Estonia, the European Community, Finland, Germany, Latvia, Lithuania, Poland, Russia, and Sweden in 1992 and entered into force on 17 January 2000 (HELCOM, 2008). The aim of this convention is to prevent and eliminate pollution of the marine environment of the Baltic Sea Area caused by harmful substances. The Baltic Marine Environment Protection Commission, known as the Helsinki Commission or HELCOM, governs the Helsinki Convention. The commission name, HELCOM, is more often referred to when discussing the Helsinki Convention, than the convention itself. HELCOM has developed a Baltic Sea Action Plan (HELCOM, 2007a), which includes measures for oil spill preparedness. Several supporting documents have been produced, for example the HELCOM Manual on Co-operation in Response to Marine Pollution (HELCOM, 2013a) and annual exercises called BALEX DELTA are organised. This manual is intended to be the practical implementation of the OPRC Convention for the Contracting parties and includes oil spill response at sea (Volume I) (HELCOM, 2013a), spills of Hazardous and Noxious Substances (HNS) (Volume II), and oil spill response onshore (Volume III) (HELCOM, 2013b). The focus of this manual is international cooperation, rather than being a manual on oil spill response equipment and strategies. An advantage of HELCOM is that it includes Russia, but unlike the

EU Directives and similar to the IMO Conventions, the recommendations are not legally binding in sense that they have no sanctions in case of non-compliance. It is up to each Member State to decide how and when these recommendations will be adopted, although they are obliged to do so as signatories to the convention. HELCOM practical provisions are collected in the convention annexes. Annex IV Prevention of pollution from ships Regulation 4, calls upon Parties to apply MARPOL Annex I to V. HELCOM Annex VII Response to Pollution Incidents is the most relevant of the annexes for oil spill preparedness. The original 1992 HELCOM Annex VII Regulation 2: Contingency Planning that entered into force on 17 January 2000 (HELCOM, 2008) requests that (emphasis added):

"Each Contracting Party ***shall draw up a National Contingency Plan*** *and in co-operation with other Contracting Parties, as appropriate, bilateral or multilateral plans for a joint response to pollution incidents."*

HELCOM Recommendation 28E/12 from 15 November 2007 (emphasis added) states that:

"RECOMMENDS FINALLY that the Contracting States ***integrate shoreline response into National Contingency Plans****, and cooperate by conducting trainings and organising exchange programmes to ensure swift and adequate response capacity and to develop best practices."*

Thus, assuming that Contracting States have National Contingency Plans.

HELCOM Recommendation 33/2 from 6 March 2012 (emphasis added) goes on to state:

"RECALLING ALSO HELCOM Recommendation 28E/13 "Strengthening of sub-regional co-operation in response field", requiring the Contracting Parties ***to integrate shoreline response into National Contingency Plans****, and cooperate by*

conducting trainings and organizing exchange programmes to ensure swift and adequate response capacity and to develop best practices, as well as HELCOM Recommendation 31E/6 "Integrated wildlife response planning in the Baltic Sea area"."

However, HELCOM Recommendation 34E/3 from 3 October 2013 states in the *"Amendments to Annex VII "Response to pollution incidents" of the 1992 Helsinki Convention, concerning response on the shore"*, that the text for Regulation 2: Contingency Planning (emphasis and underlines added) should be amended to:

"Each Contracting Party shall have a ***National Contingency Plan for response to pollution incidents <u>at sea</u>****. Each Contracting Party shall also, as appropriate****, have contingency plans for response on <u>the shore</u>****. Such plans may be combined."*

Recommendation 34E/3 thus removes the obligation of HELCOM Member States to have a National Contingency Plan for the shoreline and implies that the National Contingency Plan was intended exclusively for pollution response the sea in previous versions of the text. This change was made to facilitate Germany, where the state is responsible for the response at sea and the federal states are responsible for their own plans (Bernt, S., email communication 4 November 2015). However, it also makes Sweden fully compliant on the issue of National Contingency Plans.

6.3.4 EU Directives

Sweden has been a member of the EU since 1 January 1995. This membership means it must incorporate EU legislation in the form of Directives and Regulations into Swedish law and will face sanctions if they do not comply. In contrast to international conventions, there is no ratification process, and the implementation and enforcement of the Directives are the only interesting processes to examine. Similar to UNCLOS, none of the Directives concerning oil spill prevention (Directives 2005/35/EC, 2009/123/EC, 2002/59/EC and 2009/16/EC) are directly relevant for oil spill preparedness onshore. There is no requirement from the EU to have a National Contingency Plan.

However, the EU has introduced mechanisms to increase oil spill preparedness. This is primarily done through the European Maritime Safety Agency (EMSA). EMSA has developed the SafeSeaNet (EMSA, 2012), a vessel traffic monitoring and information system and the CleanSeaNet (EMSA, 2013a), a satellite surveillance system for marine pollution. SafeSeaNet can warn for unwanted ships in the area and CleanSeaNet sends satellite images of suspected oil spills on a daily basis to EU Member States. In addition, EMSA has several vessels on standby, to assist in oil spill response (EMSA, 2011).

6.3.5 Budget

There is no specific budget for oil spill preparedness in Sweden. The funds for oil spill preparedness are embedded in the budgets of several different organisations and budget posts, primarily related to the environment and civil protection. Specifically, oil spill preparedness is embedded in the budgets of SwAM, the Environmental Protection Agency (EPA), SCG, MSB and its predecessors the Swedish Rescue Services Agency (SRSA) and the Crisis Preparedness Agency (CPA), as well as the funds for Crisis preparedness, the marine environment, and the general budgets for the municipalities. The most important of these organisations are shown in Chapter 5 to be: SCG, MSB, SwAM, and the municipalities. Their budgets are analysed together with the fund for crisis preparedness. The crisis preparedness fund can and is used for oil spill preparedness projects, but also for various other crisis and disaster management and preparedness projects, such as flooding and forest fires.

Between 2010 and 2015, the budgets increased slightly for SCG, MSB, and SwAM, and substantially for the municipalities, while decreasing for crisis preparedness (see Table 14) (Ek, Berg, Oscarsson, & Malm, 2014; Regeringen, 2011a). As SwAM did not exist in 2010, the budget from 2012, the first full year of operation, is used (Regeringen, 2013).

Table 14: Funding development between 2010 and 2015 in million SEK, except SwAM that is measured from 2012 (Regeringen, 2011a; 2013; 2015c).

Budget line	2010/2012	2015	Change
SwAM	192.6	208.0	108.0 %
SCG	989.5	1,040.2	105.1 %
MSB	961.0	1,043.6	108.6 %
Crisis preparedness	1,171.4	1,014.4	86.6 %
Municipalities	72,749.3	90,772.5	124.8 %
Total	**76,063.7**	**94,078.7**	**123.7 %**

Sweden had a unique political situation during December 2014, with government negotiations resulting in the opposition coalition budget being agreed to by the sitting government. This led to a reduction of more than 1.5 billion SEK (~180 million USD), from 6.9 billion SEK (~825 million USD) to 5.3 billion SEK (~641 million USD) for the environment compared to the government's budget proposal and more specifically 145 million (~17.4 million USD) less to the marine environment, from 1.3 billion SEK (~158.8 million USD) to 1.2 billion (~141.5 million USD) (Ek et al., 2014). However, despite these drastic changes, the budgets were still mostly similar to preceding years. The expenditures from 2000 to 2014 and the 2015 budget and opposition budget bill for the priorities and different agencies can be seen in Figure 36 (Regeringen, 2001; 2002; 2003; 2004a; 2005a; 2006a; 2007a; 2008a; 2009; 2010; 2011a; 2012a; 2013; 2014a; 2014b; 2015b; 2015a). SRSA and CPA merged to form MSB in 2009 and SwAM was created in 2011, weighing them with expenses tied to the agency creation and closing of the old agencies.

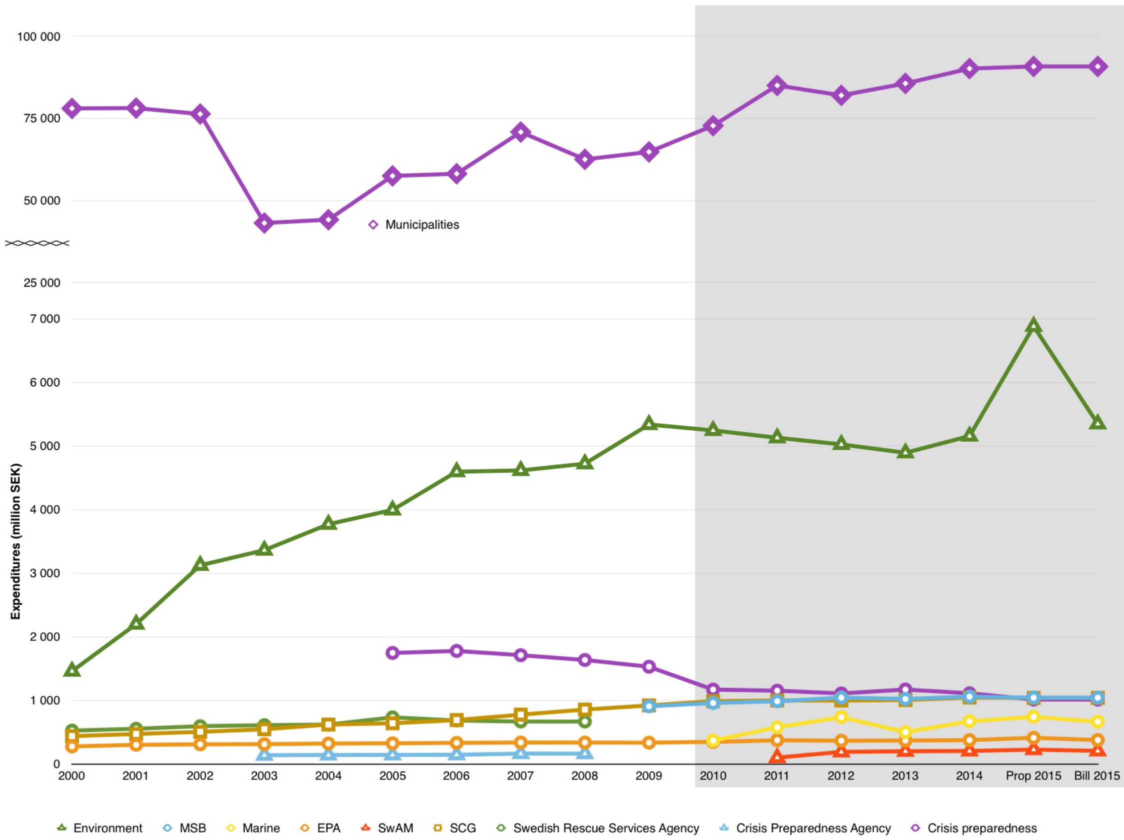

Figure 36: Expenditures change in million SEK from 2000 to 2014 and the 2015 budget and opposition budget bill for environment and crisis preparedness related agencies and municipalities (Regeringen, 2001; 2002; 2003; 2004a; 2005a; 2006a; 2007a; 2008a; 2009; 2010; 2011a; 2012a; 2013; 2014a; 2014b; 2015a; 2015b).

6.4 Discussion

One of the key issues in discussing oil spill prevention is the international nature of shipping. Coastal municipalities have in reality no direct influence on the potential risks from ships passing their coasts and rely on the government to represent them in the international forums (Baltic Master, 2007).

As shown in the results, Sweden has ratified all of the relevant IMO Conventions. However, only a few of these include provisions for oil spill preparedness directly, as most detail responsibilities and rights of the Flag and Port State. There are also issues related to both ratification and implementation of the OPRC Convention and the

Bunker Convention that warrant closer examination. This is especially related to the requirement to have a National Contingency Plan.

6.4.1 Ratification

The Bunker Convention was ratified comparably late, on 3 September 2013, several years after entry into force on 21 November 2008 (Berndtsson, 2013; Jacobsson, 2009). The timing of the ratification can be compared to the other examined conventions (see Table 12), where Sweden has ratified well in advance of entry into force. It is also surprising considering that the last oil spills in the area, for example *Fu Shan Hai* 2003, *Full City* 2009, *Godafoss* 2011, and *Golden Trader* 2011, were not from tankers, but bunker fuel from cargo vessels. The delay in ratification has been despite pressure from MSB to expediate the process (Ericsson, M., personal communication, October 2011). MSB is responsible for the oil pollution compensation claims in Sweden from the municipalities to the insurers. No particular reason for the delay has been given, despite multiple inquiries from MSB, which can be interpreted as a lack of priority and therefore commitment by the government.

6.4.2 Implementation

The most relevant of the international conventions for implementation proved to be the OPRC Convention. One of the goals of this convention was to have means to encourage countries, particularly developing countries, to establish national response systems (Holt, 1993). With that perspective, the provisions concerning the national obligations are the most important part of the convention. Sweden was one of the first states to ratify the OPRC Convention and remained active by helping to fund IMO's training programme of OPRC seminars and workshops (Edwards, 1993).

Sweden fulfils its obligations to the OPRC Convention for articles requiring implementation, except one. Article 6 states that (emphasis added):

1) *"Each Party shall establish a national system for responding promptly and effectively to oil pollution incidents. This system shall include as a minimum:*

a) the designation of:

i) the competent national authority or authorities with responsibility for oil pollution preparedness and response;
ii) the national operational contact point or points, which shall be responsible for the receipt and transmission of oil pollution reports as referred to in article 4; and
iii) an authority which is entitled to act on behalf of the State to request assistance or to decide to render the assistance requested;

b) ***A National Contingency Plan for preparedness and response*** *which includes the organizational relationship of the various bodies involved, whether public or private, taking into account guidelines developed by the Organization."*

SCG is the designated Swedish contact point for the OPRC Convention, explicitly stated in §12:3 in the government's instructions (Regeringen, 2007c). Since the jurisdiction of SCG is limited to the state waters including the great lakes, the responsibility for planning once the oil reaches land is outside of its jurisdiction. Oil spill preparedness on land is nationally coordinated by MSB, but the responsibilities of the coastal municipalities, as discussed in Chapter 5 (Kulander et al., 2004; MSBHaV, 2014; NSO, 2014b). Contrary to the instructions to SCG, the government's instructions to MSB do not explicitly mention the OPRC Convention (Regeringen, 2008b). Swedish municipalities are autonomous authorities and MSB has no mandate to order the municipalities to develop oil spill contingency plans. Thus, MSB may only encourage and recommend the municipalities to develop such plans. Although a coordinating agency, MSB is not required to have a National Contingency Plan and indeed does not (NSO interview, January 2015). This makes the role of SCG as a national contact point for the OPRC Convention puzzling, as its responsibility is only oil at sea and becomes a municipal issue once the oil comes ashore (MSBHaV, 2014; Regeringen, 2007c). It seems a little odd that the coordinating agency, namely SCG, does not have any authority over the other responisible authorities, namely the municipalities regarding oil spill issues.

On land, the municipalities have the responsibility for (unofficial translation) (Sveriges Riksdag, 2003):

"... rescue services that the State or Municipalities are responsible for after an accident or impending risk of an accident to prevent or limit damage to people, property or environment."

However, there is no explicit law in Sweden that requires a municipality to clean up an oil spill once the emergency phase has ended (MSBHaV, 2014). The closest requirement is the obligation of a municipality to keep the municipality tidy, but this law was intended for garbage and litter, not for oil spills (MSBHaV, 2014). The municipalities are independent and little to no coordination regarding oil spill clean-up exists, excepting through Rescue Service Associations and cooperation with neighbouring municipalities, as discussed in Chapter 5.

In Sweden, there is no and has never existed a National Contingency Plan, according to senior experts (NSO interviews, January 2015 and Lindén, O., Fejes, J., and Evans, S., separate telephone communications, October 2014). The closest documents that exists are strategic documents (Kulander et al., 2004; NSO, 2014b), guidelines (Kulander et al., 2010; Rylander et al., 2006), and the Emergency Response Plan of SCG. The SCG plan could be considered a national plan, as it covers the national jurisdiction at sea (NSO interviews, January 2015). Most likely, this plan has been interpreted internationally in IMO to be the Swedish National Contingency Plan (O'Hagan, C., email communication, 16 March 2015 and McKendrick, D., email communication 17 March 2015). However, the SCG emergency response plan should not be counted as a National Contingency Plan because: a) it only covers one organisation: SCG, and b) it does not apply to oil spills once they have come ashore, as that is the responsibility of the municipalities. In theory, the response capability of SCG is only as shallow as the draught of their response vessels, as they cannot go all the way onto shore. In practice, SCG cooperates with the municipal rescue services on oil spill response in the shallow areas (MSBHaV, 2014).

A key requirement from the OPRC Convention Article 6§1b is:

"… which includes the organizational relationship of the various bodies involved, whether public or private …"

Both the SCG Emergency Response Plan and the MSB document *Oil Combating along the Swedish Coastline and in the Major Lakes up to 2010*, lists the organisations involved in oil spill preparedness and outlines their responsibilities (Kulander et al., 2004). However, the MSB document explicitly states that:

"The document Oil Combating along the Swedish Coastline and in the Major Lakes up to 2010 is intended as a strategy and policy document."

Thus, the MSB strategy document was never intended to be a National Contingency Plan, although the document includes the general planning content recommended in industry guidelines (IPIECA, 2007; ITOPF, 2011b).

Since the OPRC Convention is a specific convention set by IMO, it is reasonable to assume that issues onshore were never considered during its development. However, considering the damage to the shore that *Torrey Canyon* and other accidents caused (Smith, 1968) and the IMO reference to the plan as a written document in its *Manual on Oil Pollution Section II - Contingency planning* (IMO, 1995), this assumption is invalid. A fair point is that many countries in Europe have a more centralised organisation for oil spills, with one authority taking responsibility for both sea and land, for example the German Central Command for Maritime Emergencies (Haveriekommando) and Norwegian Coastal Administration (Kystverket) (ITOPF, 2012a; Ly, 2012; VPS, 2014).

Results from the NSO interviews (January 2015) responding to the statement *"Sweden needs a national oil spill contingency plan"* show a difference of opinion, with three against and four in favour (see Figure 37).

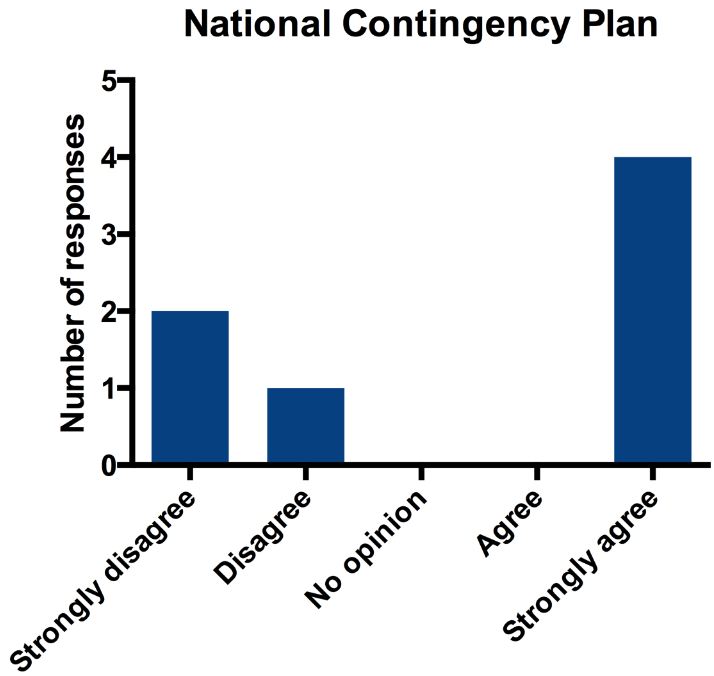

Figure 37: Expert opinion on the statement "*Sweden needs a national oil spill contingency plan*".

Informants argue that:

- A National Contingency Plan might not be possible to have because of the wide variety of different organisation, funds, coastline, and resources that the Swedish municipalities have.
- Such a plan could be used to plan and prioritise resources better regionally and nationally, clarify responsibilities, and disseminate knowledge.
- It could be a standard or guide to measure the work on oil spill preparedness for municipalities, SCG, MSB, and other parties.
- Regardless, better coordination between municipalities, counties, and agencies is needed.

The responses indicate why Sweden does not have a National Contingency Plan for oil spills. Logically, all of the interviewed agencies need to agree that a plan is needed, before such a plan will be written. All of the agencies are responsible for a part of such a plan. The current draft action plan (NSO, 2015) developed by NSO and tied to the revised Swedish Strategy for Oil Spill Preparedness (NSO, 2014b) could not be interpreted as a National Contingency Plan, as it primarily outlines priority areas for the strategy to work on. The NSO interviews also reveal differing opinions concerning the exact content of a National Contingency Plan, which naturally impacted the responses on the necessity of having a plan or not. The OPRC Convention refers to IMO manuals on oil spill contingency planning and these guides are updated regularly (IMO, 1995; 2005; 2009; 2011). There are other guides from the International Petroleum Industry Environmental Conservation Association (IPIECA, 2007) and the International Tanker Owners Pollution Federation (ITOPF, 2011b) that are also used internationally. However, none of these guides give a complete plan that can cover different countries and situations. Instead, they provide useful advice for content and reflection for countries to consider when developing their own plan. In the end, it is up to each country to decide what to include in their National Contingency Plan.

6.4.3 Funding

The recent changes in budget shows a 13% drop in national funding for crisis preparedness, but a 25% increase in the general funding to the municipalities (see Table 14). However, this change does not address the allocation of funds to oil spill preparedness within the agencies and municipalities. Furthermore, the drop in funds for Crisis preparedness may partially have been reallocated to the newly created MSB, since the funds for the Crisis Preparedness Agency (CPA) (165 million SEK), the Swedish Rescue Services Agency (SRSA) (669 million SEK), and the drop for the Crisis preparedness (106 million SEK) roughly adds up to the MSB budget for its first year (907 million SEK). The funding development between 2000 and 2015 in Figure 36 illustrate the trend of increased budget for environmental issues and marine issues overall, which has not transferred into oil spill preparedness.

There is a slight increase in funding for the major agencies and organisations involved in oil spill preparedness, except for Crisis preparedness, meaning that any change in the organisations' activities regarding oil spill preparedness is due to changes in priorities within the respective organisations or their instructions from the government. This invalidates any arguments that oil spill preparedness has decreased because of a decrease in the governmental funding.

Despite the budget being increased, two oil spill preparedness assets have been changed between 2010 and 2015. Firstly, the Oil Spill Advisory Service (OSAS) at Sweco has ceased to exist on a governmental contract (NSO interviews, January 2015), as this contract was not renewed by SwAM at the end of 2014. However, the oil spill expertise remains in the organisation, and is hired as consultants for various smaller spills, such as ruptured oil tanks on trucks. Secondly, the Depots have been moved from five rescue services stations to five SCG coastal stations, elaborated in Chapter 8.

6.4.4 Implications

No legal sanctions exist that can be used against a ratifying state that fails to comply with implementing any IMO Convention. There is no penalty for either failure to comply or for ineffectiveness to comply (Boisson, 1999). In comparison, not implementing an EU Directive within the prescribed time could potentially lead to fines (Bux, 2014). This would have an impact on the EU Member States if they have not implemented the MARPOL provisions laid out in EU Directive 2005/35/EC. However, the OPRC Convention is presently not included in any EU Directives. Sweden is not the only country that has ratified the OPRC Convention, without having a National Contingency Plan. For example, Cape Verde, Djibouti, Guyana, Lebanon, Liberia, Libya, and Madagascar do not have any National Contingency Plans either (ITOPF, 2012a).

The removal of the requirement to have a National Contingency Plan from the HELCOM Convention text after so many years seems like a strange formulation. In order to solely satisfy the German requirements, the requirement could perhaps have been worded differently.

The scores of the analysed variables for oil spill prevention in this chapter have been summarised in Table 15.

Table 15: Scores for the H2 variables.

	Preferable	*Sufficient*	*Insufficient*	Score
Number of conventions	95% or more of the 11 relevant international conventions ratified.	From 50% up to 95% of the 11 relevant international conventions ratified.	Less than 50% of the 11 relevant international conventions ratified.	**100%**
Conventions implemented	95% or more of the 11 relevant international conventions implemented.	From 50% up to 95% of the 11 relevant international conventions implemented.	Less than 50% of the 11 relevant international conventions implemented.	**90.9%**
Number of agreements	95% or more of the 4 relevant international agreements signed.	From 50% up to 95% of the 4 relevant international agreements signed.	Less than 50% of the 4 relevant international agreements signed.	**100%**
Agreements implemented	95% or more of the relevant international agreements implemented.	From 50% up to 95% of the relevant international agreements implemented.	Less than 50% of the relevant international agreements implemented.	**100%**
Preparedness funding	Funding for preparedness measures and agencies is increased by more than 5% from 2010 to 2015.	Funding for preparedness measures and agencies is stable and does not deviate more than +/- 5% from 2010 to 2015.	Funding for preparedness measures and agencies is decreased by more than 5% from 2010 to 2015.	**123.7%**

As shown by the analysis in Table 15, most of the variables were ranked *Preferable.* Even though Sweden does not fulfil the requirement to have a National Contingency Plan in OPRC Convention Article 6 §1b, all international conventions are ratified and implemented, all international agreements are signed and implemented, and sufficient budget for the relevant government agencies and municipalities to maintain oil spill preparedness is provided, and the hypothesis:

H2 – Political commitment is sufficient

is accepted and the null hypothesis $H2_0$ is rejected.

6.4.5 Limitations

Since no budget is specifically earmarked for oil spill preparedness, only a crude estimate can be made for the budget, both nationally and for the agencies. However, this is still indicative of the political commitment. If no changes exists in the budget or instructions assigned by the government, any changes to oil spill preparedness would be due to priorities within the organisation.

6.5 Conclusion

Sweden follows the political commitment for safety and environmental protection by having all international conventions related to oil spill preparedness ratified and taking an active part in implementing and enforcing international agreements.

Sweden does not fulfil the OPRC Convention requirement to have a National Contingency Plan. However, IMO has no legal sanctions for States that do not comply with its Conventions. It is remarkable that a National Contingency Plan has not yet been developed in Sweden, especially when all of the other conventions have been implemented and the nation is active in all regional agreements. The Emergency Response Plan of the Swedish Coast Guard have been interpreted internationally to be the National Contingency Plan, but neither this nor the strategy document developed by the Swedish Civil Contingencies Agency fulfils the criteria for National Contingency Plans as defined in the OPRC Convention. However, the response system in Sweden exists despite the lack of a documented National Contingency Plan, so a plan does not seem necessary in either practical or legal sense. Half of the interview informants did not acknowledge a need for a National Contingency Plan. However, developing a National Contingency Plan could be a good opportunity to address problems that are consistently identified in exercise and real spill evaluations. If done correctly developing a National Contingency Plan could be an opportunity to harmonise requirements for the oil spill organisations, clarify division of responsibilities, and regulate training and exercise requirements.

Chapter 7 - Planning

The third of the five results chapters focuses on the oil spill preparedness topic of planning and specifically the Swedish system for oil spill contingency planning. It examines planning measures for governmental agencies, County Administrative Boards (CABs), and the status of oil spill contingency planning in Sweden.

7.1 Introduction

A key issue for controlling the impacts of an oil spill is preparedness to manage a response and to clean up the oil. This is ideally accomplished through planning and exercises to continuously improve the plan and proficiency of the managers and responders. A well prepared response may save time and money, and decrease the impact of an oil spill on the environment (IPIECA, 1994a; ITOPF, 2011b). Oil spill planning is defined in this dissertation as background knowledge and planning measures, such as risk assessments, contingency planning, and increasing awareness of oil spill impacts. The content of an oil spill contingency plan varies significantly due to differing policies and regulations (ITOPF, 2011b). It usually includes strategic policy (e.g. division of responsibilities, preferred response techniques, and training requirements), operational procedures (e.g. notification routes, waste management routines, and logistics), and an information directory (e.g. contact information, documentation support, and legislation).

There is a tendency to equate contingency planning with a written plan, and a belief that this plan is evidence of preparedness (Perry & Lindell, 2003). Planning is in fact a continuous process, and the contingency plan represents a specific point in time. Preparedness is a dynamic and on-going process of which a written plan is an important part, but not a condition for, emergency preparedness. However, the process of developing a contingency plan provides opportunities to clarify responsibilities, response strategies, operational procedures, and identify problems. Most importantly, there is a need to exercise the plan, to see how it works and how it can be improved. In many cases, the importance of contingency planning is not appreciated until an accident actually happens (Purnell & Zhang, 2014). Several plans have been developed or first updated in the wake of an accident, not least after *Fu Shan Hai* in Sweden 2003.

Acknowledging that an effective response to an oil spill depends on the level of preparedness of the organisations and individuals involved, the oil spill industry (IPIECA, 2007; IPIECAOGP, 2015; ITOPF, 2011b; Taylor, Steen, Meza, Couzigou, Hodges, Miranda, Ramos, & Moyano, 2008b) and various governments have published numerous guides on contingency planning (ACS, 2012; Kulander et al., 2010; Nuka Research and Planning Group LLCPearson Consulting LLC, 2010; Sjöfartsverket, 2005).

Around the Baltic Sea, much oil spill contingency planning has been done by HELCOM (HELCOM, 2013a; 2013b) and in the last years primarily through EU projects, for example BRISK, EnSaCo, and Baltic Master II. These projects have developed guides (Emmelin & Haglund, 2012; MSB, 2011; Pålsson, 2011; Pålsson & Nilsson, 2011), risk assessments (BRISK, 2011; Brunila & Storgård, 2012; COWI, 2012c; J. Johansson & Molitor, 2011; MSB, 2013b; Rådberg & Gyllenhammar, 2012; Staskiewicz, 2011; Viertola, 2013), and sensitivity mapping (COWI, 2012a; Depellegrin et al., 2010; Emmelin & Haglund, 2012; Forsman, 2012a; Lundius, 2011; Staskiewicz, 2011) to help the contingency planning process in the project partner countries. In addition, the plans have been extensively tested during exercises (Forsman, 2012b; Ljungkvist, 2011; MSB, 2012). Much of the work within these projects has taken place in Sweden.

As explained in Chapter 6, Sweden does not have a National Contingency Plan for oil spill preparedness. At sea, the Swedish Coast Guard (SCG) follows its Emergency Response Plan. On land, emergency preparedness is the responsibility of each individual municipality (Sveriges Riksdag, 2003). The Swedish Civil

Contingencies Agency (MSB) is responsible for national coordination of oil spill preparedness (Regeringen, 2008b). Regional oversight is the responsibility of the County Administrative Boards (CABs) (Regeringen, 2007e), meaning coordination and audit. However, this does not give any agency the authority to require a municipality to have an oil spill contingency plan. Previous evaluations (MSBHaV, 2014; Riksrevisionen, 2006) point out that there is no requirement for the coastal municipalities to have an oil spill contingency plan. However, §8 of the Civil Protection Act (2003:778) (Sveriges Riksdag, 2003) requires municipalities to have an action programme for civil protection. This act requires the municipalities to specify the aim of the programme and include a risk assessment of possible emergency situations that can occur in the municipality. This programme must also include an assessment of the municipal capability, including resources, to handle such situations and any plans to acquire such capability. The capability is required to be specified both for times of peace and during times of heightened alert. The oil spill response strategy and guide produced by MSB in 2004 encourages the municipalities to develop an oil spill contingency plan (Kulander et al., 2004). This document has been the guiding document for oil spill preparedness in Sweden, until the publication of a new strategy in 2014 (NSO, 2014b). However, MSB does not have the authority to order the municipalities to develop an oil spill contingency plan. This can only be recommended and encouraged, limiting the management options.

In order to have sufficient background knowledge to develop a good oil spill contingency plan for an area, there is a need to carry out risk assessments for oil spills, and obtain information about environmental, economic, and cultural sensitivities that could be impacted in case of an oil spill. Information regarding these sensitivities is often collected in a database with a map interface (Forsman, 2012a; IPIECA et al., 2012; ITOPF, 2011b). It is important to know the scale, content, and age of the data, in order to make correct assumptions regarding its reliability. The primary information needed during an oil spill response is to know the coastline characteristics and its environmental sensitivity, followed by an oil spill trajectory forecast. This is vital information to be able to prioritise the response (Depellegrin et al., 2010; Forsman, 2012a; Staskiewicz, 2011).

The national system of environmental sensitivity mapping in Sweden is called the Digital Environmental Atlas (Liljeberg & Martinsson, 2008). This atlas can be regarded as a tool to help municipalities and CABs prioritise sensitive coastal areas during contingency planning and during oil spill response (Forsman, 2012a; Liljeberg & Martinsson, 2008; Lundius, 2011). The majority of the Swedish municipalities use this Digital Environmental Atlas, although some still use their own system (Pålsson et al., 2011; Pålsson & Wåhlander, 2013). The Swedish oil spill trajectory forecast model is called SeaTrack Web and available by request from the Swedish Meteorological and Hydrological Institute (SMHI) (U. Johansson & Olsson, 2013).

7.2 Methods

Chapter 7 has analysed the state of contingency planning in Sweden in order to evaluate if existing measures are sufficient. The number of contingency plans among the municipalities has been analysed along with resources and sharing of information and best practices through external projects. The content of these contingency plans has not been evaluated, as the process of developing a plan is more important than the document itself.

7.2.1 Study design

The issues described above are formulated as Hypothesis 3, H3:

H3 – Contingency planning measures are sufficient

Which gives the null hypothesis:

$H3_0$ – Contingency planning measures are insufficient

Hypothesis 3 was chosen to analyse measures affecting oil spill contingency planning. The units of analysis have been chosen based on reasoning and practicality after consulting literature and expert opinions.

The background of oil spill contingency planning is determined by risk assessments for oil spills and knowledge about the environmental sensitivity to oil. The number of oil spill contingency plans determines the state of planning in Sweden. The organisations themselves need to prioritise oil spill contingency planning, determined by the allocated staff resources and budget. Outreach in order to learn and share information is determined by participation in external oil spill projects. The relationship between the units of analysis and their corresponding variables can be seen in Figure 38.

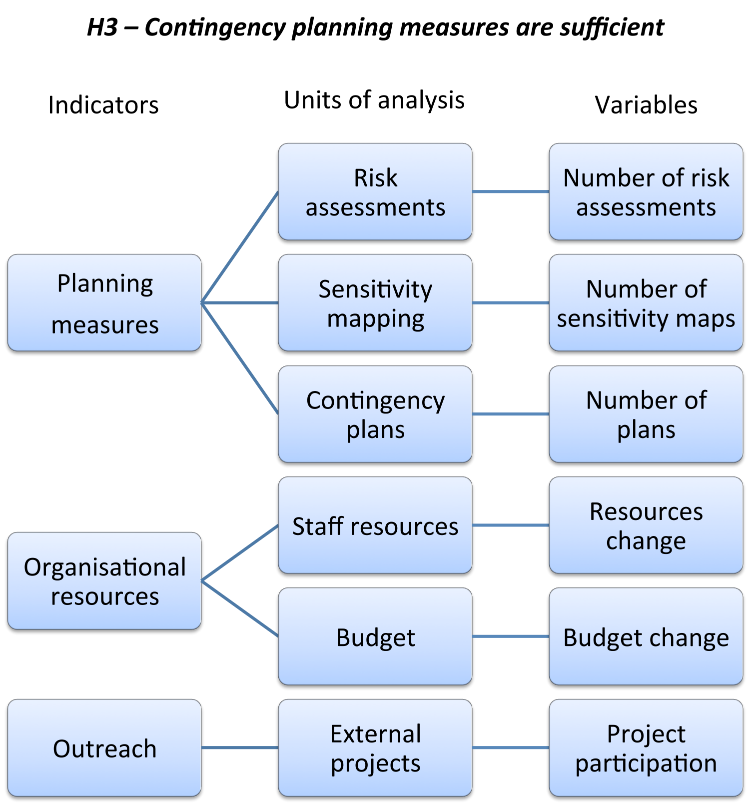

Figure 38: Hypothesis 3 chosen indicators, units of analysis, and variables.

For Sweden to have sufficient oil spill contingency planning measures, the municipalities and CABs should have an updated oil spill contingency plan, based on a risk assessment and taking into account sensitive areas, and continuously exercise and revise the plan. However, it could also be argued that measures are sufficient if a positive trend can be shown and an increasing number of organisations are developing and revising their contingency plans.

These criteria have been quantified in Table 16, following the reasoning for ranking the variables in Chapter 4.

Table 16: Evaluation criteria for H3.

	Preferable	*Sufficient*	*Insufficient*
Municipal risk assessments	95% or more of the municipalities have a risk assessment.	From 50% up to 95% of the municipalities have a risk assessment.	Less than 50% of the municipalities have a risk assessment.
CAB risk assessments	95% or more of the CABs have a risk assessment.	From 50% up to 95% of the CABs have a risk assessment.	Less than 50% of the CABs have a risk assessment.
Sensitivity maps	95% or more of the municipalities use a sensitivity map.	From 50% up to 95% of the municipalities use a sensitivity map.	Less than 50% of the municipalities use a sensitivity map.
Municipal contingency plans	95% or more of the municipalities have a contingency plan.	From 50% up to 95% of the municipalities have a contingency plan.	Less than 50% of the municipalities have a contingency plan.
Municipal plan revision	95% or more of the municipalities have a contingency plan revised within the last 5 years.	From 50% up to 95% of the municipalities have a contingency plan revised within the last 5 years.	Less than 50% of the municipalities have a contingency plan revised within the last 5 years.
CAB plan revision	95% or more of the CABs have a contingency plan revised within the last 5 years.	From 50% up to 95% of the CABs have a contingency plan revised within the last 5 years.	Less than 50% of the CABs have a contingency plan revised within the last 5 years.
Municipal staff resources	Respondents consider staff resources to have increased, average score of 1.0 or above.	Respondents consider staff resources to remain the same, average score from 0.0 up to 1.0.	Respondents consider staff resources to have decreased, average score below 0.0.
CAB staff resources	Respondents consider staff resources to have increased, average score of 1.0 or above.	Respondents consider staff resources to remain the same, average score from 0.0 up to 1.0.	Respondents consider staff resources to have decreased, average score below 0.0.
Municipal budget	Respondents consider budget to have increased, average score of 1.0 or above.	Respondents consider budget to remain the same, average score from 0.0 up to 1.0.	Respondents consider staff resources to have decreased, average score below 0.0.
CAB budget	Respondents consider budget to have increased, average score of 1.0 or above.	Respondents consider budget to remain the same, average score from 0.0 up to 1.0.	Respondents consider staff resources to have decreased, average score below 0.0.
Municipality external projects	95% or more of the municipalities have been	From 50% up to 95% of the municipalities have been	Less than 50% of the municipalities have been

	partners in one or more external project.	partners in one or more external project.	partners in one or more external projects.
CAB external projects	95% or more of the CABs have been partners in one or more external project.	From 50% up to 95% of the CABs have been partners in one or more external project.	Less than 50% of the CABs have been partners in one or more external projects.

These levels correspond to if a variable is wholly present and/or functioning (*Preferable*), partially present and/or functioning (*Sufficient*), or not present and/or functioning at all (*Insufficient*). All of the units of analysis will have to demonstrate that they at least reach the rank of *Sufficient* for H3 to be accepted, meaning that the oil spill planning measures are sufficient, but should be further developed. If all variables are ranked *Preferable*, oil spill planning measures are at the best practice level. If any of the variables are ranked *Insufficient*, important oil spill planning measures are missing, negatively impacting Swedish oil spill preparedness.

7.2.2 Sources

Primary information and comments have been collected from the questionnaire (see Appendix A - Questionnaire) sent out to all 126 coastal municipalities and 18 coastal CABs in Sweden), and the interviews (see Appendix B - Interview) with the members of the National Cooperation Group for Oil Combating (NSO), described in Chapter 4. Additional material examined are scientific papers gathered through the library at the World Maritime University (WMU), open access journals online, and project reports have been gathered from the project pages of various oil spill projects.

7.2.3 Analysis

The statistical analysis and graphs have been performed using the GraphPad Prism statistical software. Three statistical methods described in Chapter 4 have been used: ANOVA, Berger´s test, and X^2.

There is an ongoing debate on what statistical methods are most appropriate to use for Likert items (McDonald, 2014). The data in this study are treated as a measurement variable to use the more powerful parametric tests for the analyses. The Likert items used in the questionnaire were consolidated from a five-level Likert scale into a three-level (see Appendix G - Planning Results). This was done in order to decrease the degrees of freedom, to enable the use of a stronger statistical analysis. ANOVA assumes a normal distribution and an equal variance between the groups, which may not be the case in these data. However, this method is not very sensitive to moderate deviations from the normal distribution (McDonald, 2014). Another option would be the unpaired non-parametric Mann-Whitney test, which does not assume a normal distribution or a similar variance (GraphPad Software, 2015; McDonald, 2014). Unfortunately, the Mann-Whitney test cannot calculate a *p* value lower than .05 for sample sizes of seven or less (GraphPad Software, 2015), as in this case. Thus, even though the Mann-Whitney test is the most accurate, this test cannot be used on the dataset.

7.3 Results

Descriptive statistics and correlation testing have been used on the responses from the questionnaire. Two groups have been compared: the municipalities and CABs.

7.3.1 Risk assessments

Concerning risk assessment, 16 of the 60 responding coastal municipality representatives (26.7%) responded that they have a risk assessment specifically for oil spills, 41 responded that they do not have a risk assessment (68.3%) and 3 gave no comment (5.0%). All except two of the risk assessments have been carried out within the last five years.

For the CABs, 4 of the 12 respondents (33.3%) acknowledged that they have a risk assessment and 8 responded that they did not (66.3%).

7.3.2 Sensitivity mapping

Data regarding the use of sensitivity index and mapping tools were collected from older reports and are showed in Figure 39 (Pålsson et al., 2011; Pålsson & Wåhlander, 2013).

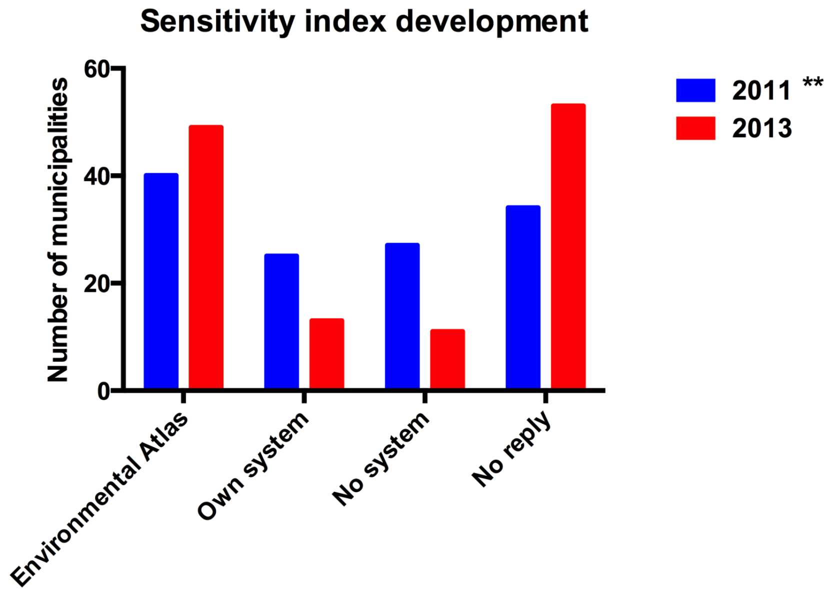

Figure 39: Use of sensitivity index systems in the Swedish municipalities.

Combining data from these reports showed that 58 of the 102 responding municipalities (56.9%) reported that they used the Swedish Digital Environmental Atlas, 21 used their own sensitivity mapping system (20.6%), 23 did not use any system at all (22.5%). Another 24 municipalities did not respond.

There is a significant difference between 2011 and 2013 (excluding the *"No reply"* option, since it contains no information), X^2 (2, N = 126) = 9.37, p = .0014.

7.3.3 Contingency planning

Extrapolating the municipality representatives to the 126 coastal municipalities they represent, 71 municipalities responded that they have an oil spill contingency plan (56%), 25 that they did not have a plan (20%) and 30 did not answer the 2015 questionnaire (24%). Data from 2011 (Pålsson et al., 2011) and 2013 (Pålsson & Wåhlander, 2013) interpreted oil spill contingency plans that were being developed as existing. Comparing with the 2013 and 2015 questionnaire data, this has been proved incorrect in a number of cases. Consequently, the raw data from the earlier reports (Pålsson et al., 2011; Pålsson & Wåhlander, 2013) have been reinterpreted and a combined dataset has been produced, showing the last available data from any of the questionnaires. This combined data reveals that the total number of Swedish coastal municipalities that have an oil spill contingency plan is 95 (79.2% of the responding municipalities) as of March 2015 and the number of contingency plans having been written or revised within 5 years is 83 (69.2%) (see Table 17).

Table 17: Compiled and combined municipal data (Pålsson et al., 2011; Pålsson & Wåhlander, 2013).

Question	Answer	2011	2013	2015	Combined
When was the plan revised?	0-5 years ago	32	46	65	83
	>5 years ago	16	16	6	12
	No plan	46	16	25	25
	No reply	32	48	30	6
	Total	**126**	**126**	**126**	**126**

The data show that the municipalities that wrote or revised their plans within the last five years doubled between 2011 and 2015, and the number of municipalities without a plan decreased (see Figure 40).

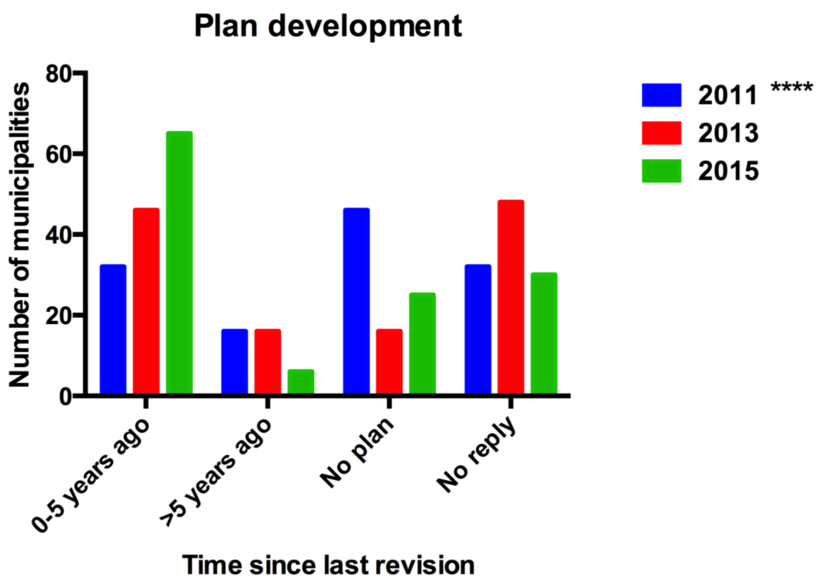

Figure 40: Time since last revision of the municipal oil spill contingency plans.

There is a significant difference between the years (excluding the *"No reply"* option, since it contains no information), X^2 (4, $N = 126$) = 30.25, $p < .0001$.

Of the 12 responding CABs, 6 responded that they have an oil spill contingency plan written or revised within the last 5 years (50%).

7.3.4 Organisational resources

The questionnaire responses for change in workload and staff during the last five years for the 50 responding coastal municipalities and the 10 responding CABs were compiled (see Table 18).

Table 18: Respondent organisational changes between 2010 and 2015.

	Municipalities		CABs	
	Budget	**Staff**	**Budget**	**Staff**
Greatly decreased	1	1	0	0
Slightly decreased	1	2	0	1
Remains the same	38	39	7	7
Slightly increased	9	7	2	2
Greatly increased	1	1	1	0
Total	**50**	**50**	**10**	**10**
Average	***0,16***	***0,10***	***0,40***	***0,10***

The agreement scale ranges from *Greatly decreased* (-2), *Slightly decreased* (-1), *Remains the same* (0), *Slightly increased* (+1), and *Greatly increased* (+2).

No significant difference was observed when comparing the consolidated responses from organisations with and without a plan concerning budget change in municipalities (see Figure 41 A), ANOVA (2, N = 50) = 7.24, p = .1213, budget change in CABs (see Figure 41 B), ANOVA (2, N = 10) = 2.85, p = .2600, and change in staff resources in municipalities (see Figure 41 C), ANOVA (2, N = 50) = 7.00, p = .1250, except for change in staff resources for CABs (see Figure 41 D), ANOVA (2, N = 10) = 31.00, p = .0313. There is a significant difference between the CABs with and without a plan when examining the reported changes in staff resources.

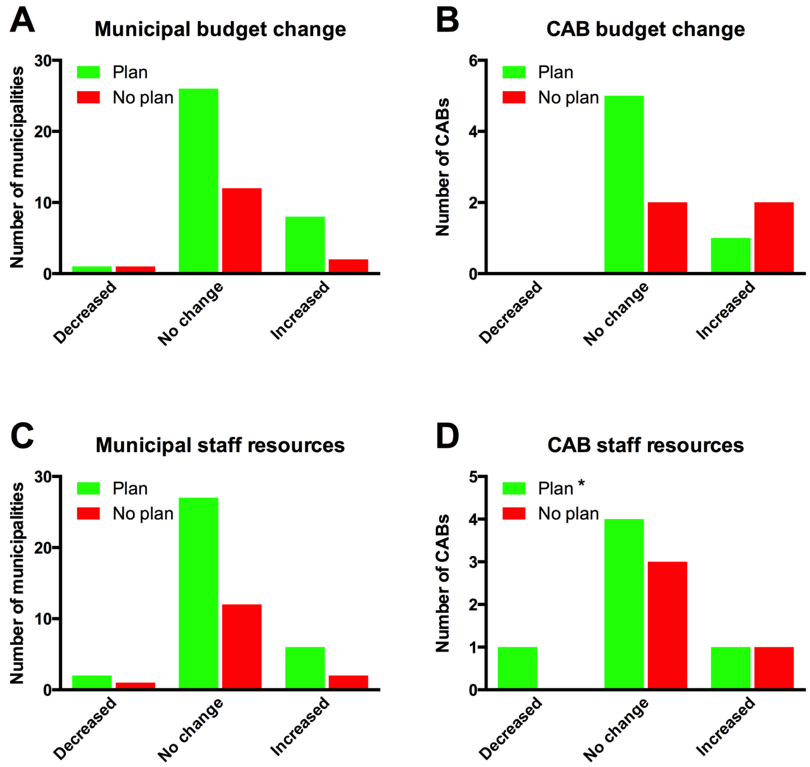

Figure 41: Changes in the organisational budgets and staff resources among municipalities and County Administrative Boards (CABs) between 2010 and 2015.

7.3.5 External projects

Out of the 50 responding coastal municipalities, 13 responded that they had been part of an external oil spill project (26%). Out of the 10 responding CABs, 4 responded that they had been part of a project (40%).

Comparing the responding coastal municipalities (see Figure 42 A) and responding CABs (see Figure 42 C), that developed or revised a plan between 2010 and 2015 with participation in external oil spill projects during the same time, no significant difference in proportions of the variables was found, Berger's test (N = 50), p = .2282 for A and (N = 10) p = .5303 for C. Combining data on the 39 of the municipalities listed as partners in EU oil spill projects (ARCHOIL, Baltic Master II, and EnSaCo), no significant difference was found (see Figure 42 B), Berger's test (N = 120), p = .0814.

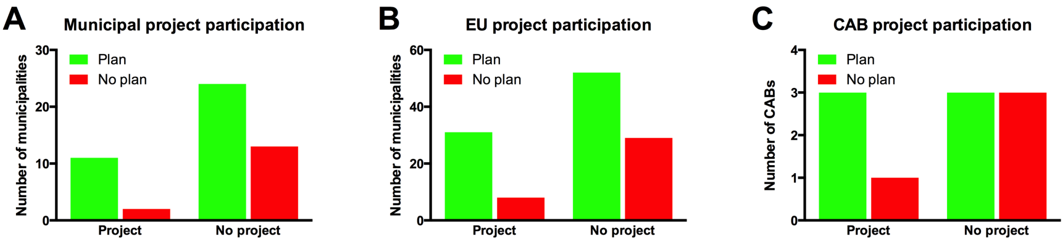

Figure 42: Project participation and contingency planning among municipalities and County Administrative Boards (CABs) between 2010 and 2015.

7.4 Discussion

The principal organisation impacted by an oil spill that reaches the shore will be the local municipality. Thus, they will have the most to gain from having an oil spill contingency plan. The CABs are responsible for county coordination and obliged to have a risk assessment (Regeringen, 2007e), which should make them an integral part of the municipalities' planning. This chapter has examined several indicators for planning measures in Sweden among municipalities and CABs.

7.4.1 Risk assessments

The risk assessments were not widely used as over two thirds of the responding municipalities did not have a risk assessment for oil spills. It was particularly surprising that not more of CABs have risk assessments. Only 4 of 18 CABs confirmed that they have a risk assessment for oil spills. In the instructions to the CABs from the Government (Regeringen, 2007e), §54:4 explicitly requires CABs to maintain regional risk- and vulnerability analysis for use by themselves and other stakeholders' emergency preparedness. All CABs have a risk- and vulnerability analysis, but the content varies between the counties. The intent of the risk- and vulnerability analysis requirement is that there is no need for individual municipalities in the area to develop their own risk assessments. The municipalities should be able to rely on the regional risk- and vulnerability analysis developed by the CABs. Many of the municipalities are small or do not have a long coast line, which makes pooling resources to produce regional risk- and vulnerability analyses pragmatic. The low number of risk analyses may reflect a reliance on national oil spill risk assessments (MSB, 2013b; Rådberg & Gyllenhammar, 2012), or assessments funded through projects such as Baltic Master II (J. Johansson & Molitor, 2011) and BRISK (BRISK, 2011; COWI, 2012c).

7.4.2 Sensitivity mapping

The Digital Environmental Atlas was commissioned from the consultancy IVL Swedish Environmental Research Institute (IVL) working with the CAB of Västra Götaland by the Environmental Protection Agency (EPA) from 2003 to 2007 (Forsman, 2012a). The finished web-based application has been available for free online since 2008. The Digital Environmental Atlas was then delivered from EPA to the CABs, who debated for several years which of them would be responsible. In 2010, a decision was made that it would be located at the CAB of Västra Götaland in Gothenburg. A management group was created in 2011, and goals and tasks were decided and distributed (Georgieva Lagell, A., email communication, 7 July 2013). The system was planned to transfer to a newer platform, which would increase the user friendliness and therefore the practical use. Unfortunately, the work stalled again because of a lack of funds and interest (Georgieva Lagell, A., telephone communication, October 2013). The system has now been transferred, but is in need of an update, as some transcription errors have occurred with the data.

The NSO interviews (January 2015) regarding a national coastal sensitivity map show a strong unanimous support for such a tool and more specifically the Digital Environmental Atlas. All seven respondents strongly agreed with the statement *"Sweden needs a coastal environmental sensitivity map"*. The respondents argued that the Digital Environmental Atlas is the only tool to make environmental assessments and classify sensitive areas. All respondents agree that there is a need to assess the habitats of the coastline, in order to make the correct priorities to protect sensitive areas during an oil spill. Additionally, such information could be used in risk assessment and preparedness, for example to designate suitable places of refuge, or suitable areas for anchoring and lightering of distressed ships. One respondent was more specific, explaining that a sensitivity map tool is necessary, but its usefulness is tied to its user friendliness.

Other tools besides the Digital Environmental Atlas exists, shown by the Baltic Master II (Pålsson et al., 2012) and the Baltic Maritime Science Park Oil Spill Forum questionnaires (Pålsson & Wåhlander, 2013). For example, CABs have other GIS tools they use for other purposes. Development of the user interface and move from an obsolete platform to a modern GIS platform has been discussed for years (A. Georgieva Lagell, telephone communication, October 2013), and has recently come to pass. However, optimisation and evaluation is needed, as there are still data translation errors (Länsstyrelsen Västra Götaland, 2007).

Environmental priorities need to be agreed between the municipalities and by the CABs in advance, before the Digital Environmental Atlas will be a useful decision tool. However, some municipalities are not aware of the uses of the Digital Environmental Atlas or even of its existence.

Additionally, update of the basic data in the Digital Environmental Atlas is needed. Most of the existing data is digitised information from a 1969 survey (Liljeberg & Martinsson, 2008). The EU projects, specifically ARCHOIL (NSO interviews, January 2015), Baltic Master II (Lundius, 2011) and, EnSaCo (Forsman, 2012a) have updated this data in many of their project partners' municipalities.

The need for further development as well as funding is acknowledged by the government in the draft NSO Action plan, but no concrete plans for how to do this is mentioned (NSO, 2015). No agency is still willing to accept responsibility and costs for the Atlas. This reflects the continued reluctance of any agency to take responsibility for a tool that all agree is valuable.

7.4.3 Contingency planning

Sweden does not have a National Contingency Plan for oil spills and planning requirements are not bound in Swedish law (MSBHaV, 2014), as discussed in Chapters 5 and 6. However, the coordinating agency, MSB, has for several years encouraged the municipalities to develop their contingency plan through guides (Forsman, 1997) and projects (for example the EU projects ARCHOIL, Baltic Master, and EnSaCo). It is obvious from the data that oil spill contingency planning measures have not been sufficient, as all municipalities do not have a plan. The ideal situation would be if all municipalities have a plan and were revising and exercising it frequently. Despite few but common smaller oil spills along the coast, oil spill contingency planning has historically had a low priority among the municipalities, indicated in the comments to the questionnaire. However, this situation is improving with a current historic peak of the number of municipalities with oil spill contingency plans. Looking at the data, 79.2% (corresponding to 95 of the responding 120 municipalities) have recently updated plans (see Table 17). The trend in development of municipal oil spill contingency plans between 2011 and 2015 is encouraging, with a doubling of the number of municipalities that have developed or revised their plan during the last five years (see Figure 40). However, these data do not reveal how many municipalities that have actually developed a new plan or revised an old one. In general, the questionnaire comments show that a greater proportion of municipalities developed their plans in 2011 compared to 2013 and 2015. However, the date a plan is developed is hard to establish. Many municipalities that formally had plans had not been using them for several years (or even decades) and admitted that revising the old plan in practice meant to replace it. Would these be considered to update an old plan or develop a new plan? The responses could not reflect this difference adequately. This issue is reflected in a few conflicting responses from the same municipality, where one respondent did not know that an old plan existed and another did. The data also reflect an increasing number of revisions of the plans, which helps to keep the plan and oil spill awareness up to date and not be forgotten.

CABs do not have any requirements to have an oil spill contingency plan. They are instructed by the government to have a regional overview and coordination, and support organisations responsible for emergency preparedness in the county concerning planning, risk assessments, training, and exercises (Regeringen, 2007e). However, at least 6 out of the 18 CABs the questionnaire was distributed to have developed such a plan anyway for their own organisation. These plans are in most cases developed in close collaboration with the county municipalities in regions where there is a close collaboration between the municipalities and the CABs, for example Halland on the Swedish west coast (Länsstyrelsen Hallands Län, 2011) and Blekinge on the southeast coast (Länsstyrelsen Blekinge Län, 2011). However, the draft NSO action plan (NSO, 2015) shifts the responsibility for oil spill planning from the municipalities to the CABs, in line with recommendations made already in the 1970s (Norrby et al., 1979).

Responses from the expert interviews (January 2015), to the statement *"The existing system for contingency planning in Sweden is sufficient for national preparedness"*, show a divided opinion, with three against and four in favour (see Figure 43).

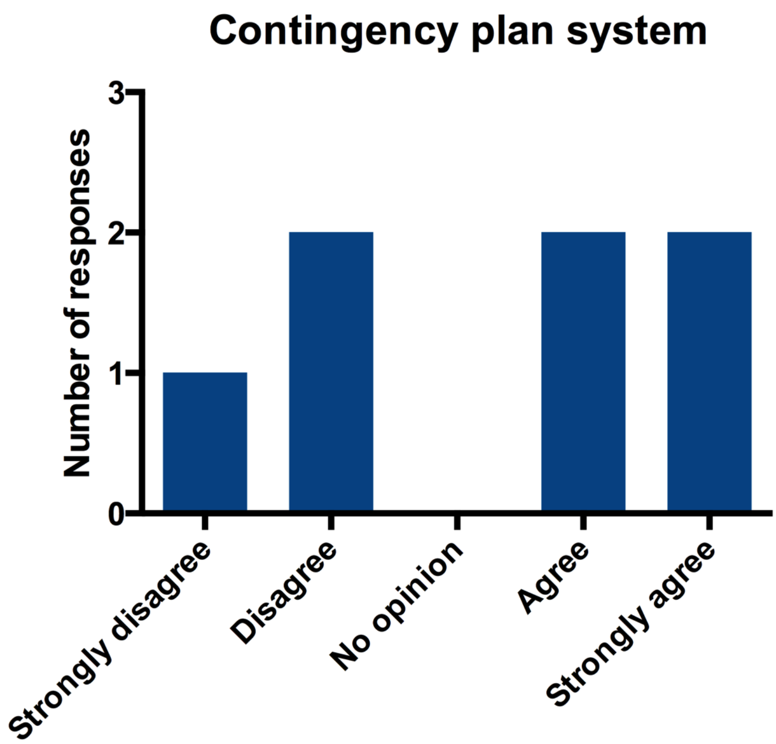

Figure 43: Expert opinion on the statement "*The existing system for contingency planning in Sweden is sufficient for national preparedness*".

Informants argue that:

- Oil spills are such a rare event and the municipalities are ill prepared to handle a spill.
- Many municipalities do not have updated plans or exercise frequently enough.
- The system in itself is sufficient, because the municipalities and CABs have the local knowledge and resources.
- What is lacking is the expert knowledge on oil, which is supplied by the national authorities.
- There is no requirement in the Swedish law to have an oil spill contingency plan or to clean up after an oil spill.

- One single national authority is responsible for oil spills at sea, which is good, but on land the issue becomes fragmented and confusing with multiple agencies and authorities sharing the responsibility.
- Multiple responsibility gaps exist, for example financial and ownership issues for oil spills from leaking wrecks.
- The main problem on land is the lack of knowledge about roles and responsibilities among the involved organisations, which is not a problem with the system itself.

The comments of the informants mirror the general opinions from the questionnaire and conclusions from the EU projects (MSB, 2012; Pålsson & Wåhlander, 2013). The complex system with multiple agencies on land responsible for different aspects of an oil spill logically leads to confusion about roles and responsibilities as was discussed in Chapter 5. Any system with a high complexity will have a lower understanding of the whole system by the individual users.

The fact that a municipality has an oil spill contingency plan does not necessarily mean that they are well prepared for an oil spill (Perry & Lindell, 2003; Tierney, 1993). This is exemplified by the *Golden Trader* oil spill that impacted the island of Tjörn in 2011. The Tjörn municipality had an oil spill contingency plan, revised in 2005 (Pålsson et al., 2011), that had never been used. Consequently, the municipality and local rescue service had to start from scratch during the initial response and subsequent clean-up (MSBHaV, 2014), even though the national Oil Spill Depots, and both international and national experts assisted them. An interesting note is that the Baltic Master II questionnaire was distributed during 2011 (Pålsson et al., 2011) and a response by the head of the rescue service on Tjörn, that would lead the oil spill response two months later, stated that Tjörn had a plan, but nobody had ever used it and it was likely not of any practical use. So the municipality was aware of the plan and that it was insufficient because it had never been used during an exercise.

7.4.4 Organisational resources

The results of the impact of the organisational resources are surprising. There are no significant differences between the changes and having a plan or not in any of the examined variables. The only significance is the CAB staff resources, but this change may be impacted by the weaker power of the ANOVA test for data with a low number of participating CABs (see Figure 41 D). The expected pattern was to see the organisations with a plan to have more budget and staff resources in order to develop the plan. In contrast, most municipalities and CABs reported no change in either of these parameters (see Figure 41 A to D), regardless of whether they had a plan or not. This suggests that a change in budget or staff might not lead to more plans being developed or revised and suggests the theory that this process is driven by other factors.

There is a significant difference in CAB staff resources in Figure 41 D between the "*Decreased*", "*No change*" and "*Increased*" categories, which does not give much further information. No significant difference was found between those with a plan and those without. It is possible that a gradual change during this time has not been perceived as an overall change by the employees, thus leading to an overestimation of the "*No change*" category. The data are difficult to interpret because of the low number (10 out of 18) of CABs that responded to these questions. Although this is taken into account by the statistical analysis, the small number of datapoints makes the analysis weaker.

7.4.5 External projects

Since 2003, several EU projects have worked to increase the preparedness level (BRISK, 2011; Ljungkvist, 2011; Pålsson & Nilsson, 2011), exercise the contingency plans (MSB, 2012), and update Digital Environmental Atlas data in Sweden (Lundius, 2011) and the Baltic Sea Region (Forsman, 2012a). As many of these EU oil spill preparedness projects were finalised in 2013, few new oil spill projects have started up in the Baltic Sea Region until 2015. Despite waning interest in oil spill preparedness, the processes initiated during these EU projects have made several municipalities develop their own oil spill contingency plans and use them in exercises during the last five years. The municipalities who answered the 2011 and 2013 questionnaires have largely been involved in the aforementioned EU projects (Pålsson et al., 2011; Pålsson & Wåhlander, 2013). Thus, the projects have concretely helped some of the Swedish municipalities involved in external projects to improve their oil spill preparedness.

Surprisingly, no significant positive impact of participating in external oil spill preparedness project is revealed in the data, when comparing plan and project (see Figure 42). There are more than twice as many municipalities that had not been part of an external project that had a plan, than municipalities that had been part of a project. However, the number of municipalities that have been part of an external project, but did not have a plan was low. This indication is true for both data exclusively from the questionnaire and from municipalities that were partners in the EU projects. It is thus concluded that being part of a project is *not* a requirement for developing an oil spill contingency plan. Of course, there are municipalities that have been part of an oil spill project and through the project have received additional funds, for example Karlskrona, Karlshamn, Ronneby, and Sölvesborg for the Baltic Master II project (Länsstyrelsen Blekinge Län, 2011). The funds covered the costs of additional employees or allocation of staff tasked with developing an oil spill contingency plan, and exercising it by the end of the project. These municipalities have obviously gained from being part of the external projects. A more detailed analysis is needed on the municipal involvement in recent projects and what they gained, in order to make a better analysis of the full impact of these projects. As before, CAB data for participation in external projects is difficult to analyse because of the low number of responses, but no significance was revealed (see Figure 42).

7.4.6 Implications

It is evident that the risk awareness among both municipalities and CABs is lower than expected. However, a good number of municipalities currently have a contingency plan in place. An analysis of the quality of the oil spill contingency plans has not been done, as literature and experience suggests that the planning process itself is more important (ITOPF, 2011b; Pålsson & Nilsson, 2011; Perry & Lindell, 2003; Purnell & Zhang, 2014). Currently, there is no national quality assurance in place for these plans and no regulations regarding content. The quality of the plans can thus vary and the plans are not harmonised nationally. However, existing plans belonging to other municipalities have generally been reviewed during preparation of the municipal contingency plans (Pålsson, 2011).

The scores of the analysed variables for oil spill planning in this chapter have been summarised in Table 19.

Table 19: Scores for the H3 variables.

	Preferable	*Sufficient*	*Insufficient*	Score
Municipal risk assessments	95% or more of the municipalities have a risk assessment.	From 50% up to 95% of the municipalities have a risk assessment.	Less than 50% of the municipalities have a risk assessment.	**26.7%**
CAB risk assessments	95% or more of the CABs have a risk assessment.	From 50% up to 95% of the CABs have a risk assessment.	Less than 50% of the CABs have a risk assessment.	**33.3%**
Sensitivity maps	95% or more of the municipalities use a sensitivity map.	From 50% up to 95% of the municipalities use a sensitivity map.	Less than 50% of the municipalities use a sensitivity map.	**77.5%**
Municipal contingency plans	95% or more of the municipalities have a contingency plan.	From 50% up to 95% of the municipalities have a contingency plan.	Less than 50% of the municipalities have a contingency plan.	**79.2%**
Municipal plan revision	95% or more of the municipalities have a contingency plan revised within the last 5 years.	From 50% up to 95% of the municipalities have a contingency plan revised within the last 5 years	Less than 50% of the municipalities have a contingency plan revised within the last 5 years	**69.2%**
CAB plan revision	95% or more of the CABs have a contingency plan revised within the last 5 years.	From 50% up to 95% of the CABs have a contingency plan revised within the last 5 years	Less than 50% of the CABs have a contingency plan revised within the last 5 years	**50.0%**
Municipal staff resources	Respondents consider staff resources to have increased, average score of 1.0 or above.	Respondents consider staff resources to remain the same, average score from 0.0 up to 1.0.	Respondents consider staff resources to have decreased, average score below 0.0.	**0.10**
CAB staff resources	Respondents consider staff resources to have increased, average score of 1.0 or above.	Respondents consider staff resources to remain the same, average score from 0.0 up to 1.0.	Respondents consider staff resources to have decreased, average score below 0.0.	**0.10**
Municipal budget	Respondents consider budget to have increased, average score of 1.0 or	Respondents consider budget to remain the same, average score from 0.0 up to	Respondents consider staff resources to have decreased, average score	**0.16**

	above.	1.0.	below 0.0.	
CAB budget	Respondents consider budget to have increased, average score of 1.0 or above.	Respondents consider budget to remain the same, average score from 0.0 up to 1.0.	Respondents consider staff resources to have decreased, average score below 0.0.	**0.40**
Municipality external projects	95% or more of the municipalities have been partners in one or more external project.	From 50% up to 95% of the municipalities have been partners in one or more external project.	Less than 50% of the municipalities have been partners in one or more external projects.	**26.0%**
CAB external projects	95% or more of the CABs have been partners in one or more external project.	From 50% up to 95% of the CABs have been partners in one or more external project.	Less than 50% of the CABs have been partners in one or more external projects.	**60.0%**

As shown by analysis of the variables in Table 19 and the occurrence of *Insufficient* ranking, indicating that only a few of the municipalities and CABs have risk assessments, not all have updated oil spill contingency plans or use environmental sensitivity maps, the organisational resources are sufficient, and that few municipalities have been partners in external projects, the hypothesis:

H3 – Contingency planning measures are sufficient

is rejected and the null hypothesis $H3_0$ is accepted. This situation is interesting, since the recommendation to develop oil spill contingency plans was emphasised by the authorities already in 2004 (Kulander et al., 2004). However, as shown by the data (see Figure 40), there has been much development in Swedish municipal oil spill contingency planning between 2010 and 2015. If this development trend continues, all Swedish municipalities may have an oil spill contingency plan within a few years.

7.4.7 Limitations

The questionnaire responses are supported by the literature and the interviews. The limitations of the study primarily concern the statistical analyses. The low power of the examined statistical tests has made the analysis of the changes in organisation relating to budget and staff resources difficult to interpret.

Likert items can be treated as a nominal variable, as a measurement variable, or as an ordinal variable (McDonald, 2014). If treated as a nominal variable, the data would be summarised by the proportion of people giving each answer and analysed with a X^2 test. As the data would turn ranked data (from least agreement to most) into separate groups without any relative position, important information would be lost (McDonald, 2014). If treated as a measurement variable, the data can be summarised by a mean and standard deviation and analysed with established parametric tests, for example ANOVA, as used in this dissertation. A valid argument against this treatment is that Likert items cannot be considered to have a normal distribution. This is because it is usually constricted by the amount of response options and the answers are just crude divisions of an opinion, meaning that the scale differences may not be entirely correct. However, ANOVA is not very sensitive to deviations from a normal deviation and has been shown to work even with small numbers of values (McDonald, 2014). The most correct way is to treat the data as an ordinal variable. This assumes that the Likert items have an inherent ranking among them, but does not assign specific values to them (McDonald, 2014). The statistical tests for ordinal variables are called nonparametric tests and do not make assumptions of a normal distribution of the data (GraphPad Software, 2015; McDonald, 2014). This makes them very useful, but less powerful than parametric tests. Measurement variables that do not have a normal distribution are often converted to ordinal variables and analysed using a nonparametric test. Unfortunately, the Mann-Whitney test cannot calculate a p value lower than .05 for sample sizes of seven or less, as in this case, meaning that this test was completely powerless to detect any differences in the data (GraphPad Software, 2015).

A possible error on the project participation data would be if the respondents misinterpreted the meaning of an external oil spill project, simply forgot that the municipality had been part of such a project, or did not know about the municipal participation in a project.

7.5 Conclusion

Sweden has historically been spared any larger oil spills, likely affecting the preparedness community to not focus on unlikely oil spills. The focus has instead been on more likely events, such as fires and car accidents. The awareness among organisations in areas that have a higher risk for oil spills, such as cities with large ports or heavy shipping traffic off of its coasts is higher. These municipalities are generally better prepared, as a greater proportion of them have oil spill contingency plans. The questionnaire responses show that development and revision of oil spill contingency plans are not uniform among municipalities or County Administrative Boards.

Oil spill contingency planning on land is more complex than at sea. Since Sweden does not have a National Contingency Plan for oil spills, the planning responsibility lies on each individual municipality, but is not required by law. The degrees to which the municipalities have developed and revised their oil spill contingency plans differ, with 79% of the municipalities having a plan. In addition, many municipalities or County Administrative Boards do not have risk assessments or use environmental sensitivity maps for planning. However, there is a clear increase in the number of municipalities developing plans during the last five years. If this trend continues, all municipalities may soon have an oil spill contingency plan. However, in the draft action plan of the Swedish Strategy for Oil Spill Preparedness, the responsibility for oil spill contingency planning is firmly lifted to the regional level. This means that it will now be the County Administrative Boards who are responsible for regional contingency plans and that these are linked to the municipal plans.

But having a plan is not enough. The plan itself is just a document. The foundation work with consulting stakeholders, finding information, and prioritising sensitive areas is crucial when developing the plan, as it raises the awareness among the involved organisations more than just giving them a copy of the finished planning document. All stakeholders must be aware that the plan exists, it must contain the relevant information to be usable, and it must be frequently updated to remain a usable and living document.

Chapter 8 - Response

The fourth of the five results chapters focuses on the oil spill preparedness topic of response and specifically the Swedish training and exercise system. It examines measures for training, exercises, and equipment for Swedish governmental agencies, County Administrative Boards (CABs), and municipalities.

8.1 Introduction

Oil spill response in this context is defined as the physical work of cleaning up the oil. Clean-up should ideally be done by trained professionals, using established methods and equipment. Trained professionals are needed to maintain health and safety issues for the responders, as oil spill clean-up can have adverse health effects if conducted incorrectly (Barnea, 1999; IPIECAOGP, 2012b; Na, Sim, & Jo, 2012; OGPIPIECA, 2012). There is a variety of methods and equipment for oil spill clean-up, for example skimmers, pumps, beach cloth, dispersants, and booms, but basic buckets and spades are also utilised (ACS, 2012; API, 2013a; Fejes, Zetterberg, Andersson, Palokangas, & Svenson, 1999; Pålsson & Lindén, 2014a). The strategies to make the response as effective as possible should be described or referenced in oil spill contingency plans.

Sweden has five national Oil Spill Depots with equipment, managed by the Swedish Civil Contingency Agency (MSB) (Kulander et al., 2004; 2010; MSBHaV, 2014). These Depots were contracted to be stored at local rescue service stations in Vänersborg, Karlstad, Visby, Botkyrka, and Umeå until April 2015. As the contract ended, the depots were relocated to the Swedish Coast Guard (SCG) stations in Härnösand, Djurö, Slite, Oskarshamn, and Gothenburg (Söder, 2015), but are still the responsibility of MSB (see Figure 44). In addition, extra equipment to reinforce the Oil Spill Depots is stored centrally in Kristinehamn.

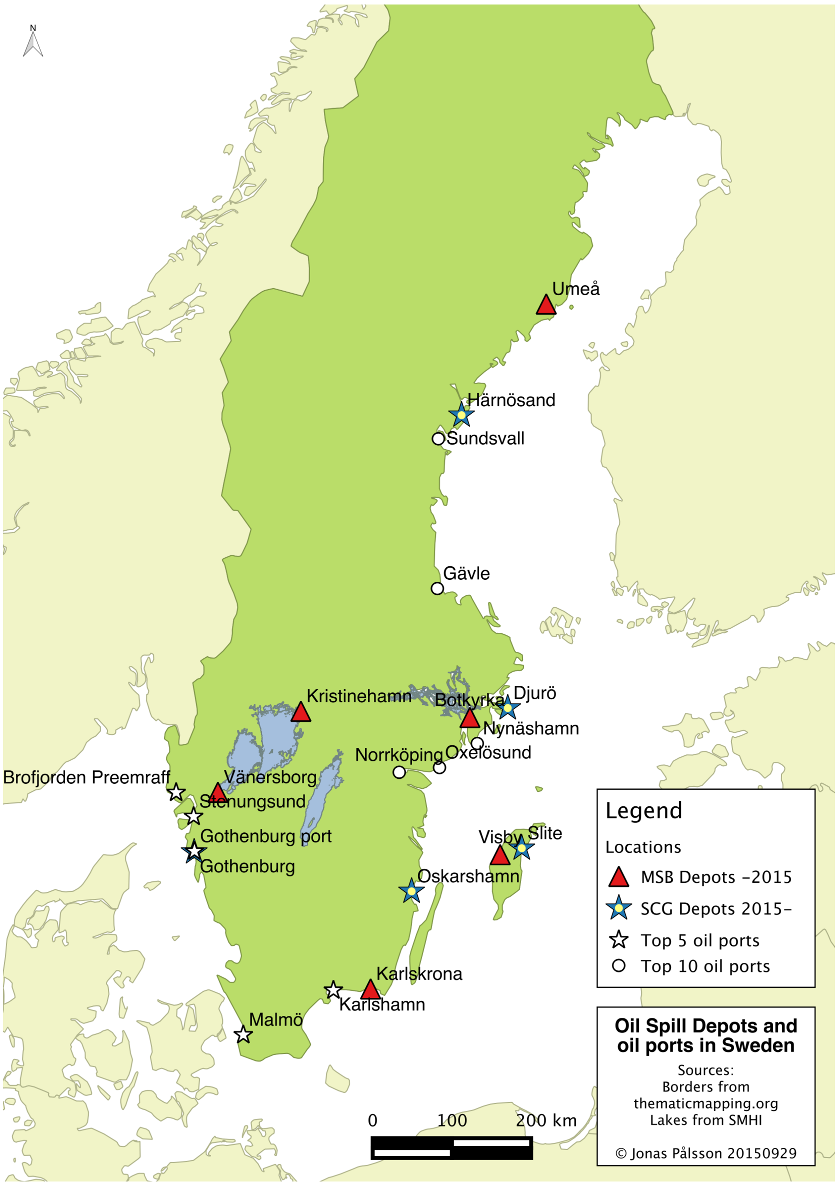

Figure 44: Oil Spill Depot locations and major oil ports in Sweden (Göteborgs Hamn, 2015; Söder, 2015).

These Depots are designed to provide supplementary material in the form of boats, barges, containers, pumps, skimmers, booms, and personal protective equipment to reinforce the municipalities during an oil spill response (M. Olsson, 2012). In addition to the municipal equipment and the Depots, additional equipment is stored with SCG and a few volunteer organisations, such as the Swedish Sea Rescue Society (SSRS) and the Swedish Wildlife Rehabilitators (KFV), and the industry, such as ports and oil companies.

The low number of oil spills in Sweden suggests that the national organisations have had few, if any, opportunities to apply and test their contingency plans during a real oil spill response. Whereas SCG exercise frequently (Kustbevakningen, 2015), not all of the municipalities conduct oil spill exercises. Exercises are pointed out as critical to maintain the ability to respond to real spills (IPIECAOGP, 2014b; Perry, 2004) and not conducting exercises will impact the ability to respond effectively to a real oil spill. This can be exemplified in the case of the *Golden Trader* oil spill that impacted the island of Tjörn. The local municipality did indeed have an oil spill contingency plan, but had not exercised it (MSBHaV, 2014). Consequently, the plan was not used and most of the response was setup in an ad-hoc fashion without a plan for an extended response operation, which subsequently requires several work shifts to mitigate fatigue among responders and managers.

During a real spill, difficult decisions must be made quickly during challenging circumstances, usually with only partial information and under time constraint (MSB, 2010). These decisions may have long-term impacts on the environment, local economy, and people's properties, health, or even lives. The choices may thus affect the reputation and the legitimacy of the organisation, in addition to its operational efficiency. Of course, it is impossible to predict everything that can happen during an oil spill. However, exercises can provide a structure and experience that can help to avoid mistakes during real spills, plug knowledge gaps, and work out bottlenecks. Good decision-making and information processes can be established in the organisations through contingency planning and functions, while inefficient or dangerous practices can be modified or eliminated. Exercises may also reveal what, and if, resources are needed and if they are put to the best use. To make the most of these exercises, there is a need for careful evaluations, communication of the evaluation results, and for the involved organisations to deal with any deficiencies identified in the evaluations.

Internationally, leading industry expert organisations like the International Petroleum Industry Environmental Conservation Association (IPIECA) and International Tanker Owners Pollution Federation (ITOPF) advocate frequent exercises, but do not detail the exact frequency (IPIECAOGP, 2014b; ITOPF, 2011b). The United States has some of the strictest environmental regulations for oil spills globally. For exercises, the United States adopted the National Preparedness For Response Exercise Program (PREP) in 1994 (Cashman, 2005; Cashman et al., 2003; NRT, 2014; Reiter, Jarvis, & Storey, 2005). This was done in order to meet the regulatory requirements for exercises set out in section 4202(a) of the Oil Pollution Act of 1990 (OPA90) (NRT, 1997). These exercises depend on the type of facility or vessel involved and the requirements have different levels of complexity, from more frequent tabletop exercises to complex events with participation from both the industry and the authorities. The requirements range from quarterly for simpler exercises, through annual regional worst-case discharge exercises, to area exercises involving multiple jurisdictions every third year.

Sweden is Party to a number of international agreements, such as the Helsinki Commission (HELCOM), the Convention for the Protection of the Marine Environment of the North-East Atlantic (OSPAR Convention) and the Copenhagen Agreement, that require joint exercises (BRISK, 2012). However, these are aimed at open sea response between the various neighbouring countries. Only a few exercises have included activities onshore, for example the Copenhagen Agreement exercise Matteus in Gothenburg 2010 (Kustbevakningen, RTJ Storgöteborg, RTJ Öckerö, 2010; Københavnsavtalet, 2010) and the BOILEX exercise in Nynäshamn, 2011 (MSB, 2012) by the EnSaCo project. In addition to these, some shoreline municipality and county-level exercises have taken place in Sweden (Ljungkvist et al., 2013; Skåne Nordväst, 2014).

MSB has many responsibilities in crisis preparedness and management, but is tasked with systematically and transparently evaluating the implementation and effects of measures to increase preparedness (MSB, 2010). The agency is active in promoting exercises, but do not themselves directly organise any oil spill exercises. However, it works closely and frequently with the municipalities and CABs who organise regional exercises, on oil spills and other issues.

Unfortunately, few universally recognised frameworks for evaluating oil spill exercises exists. Several different frameworks have been developed, for example by the International Organization for Standardization (ISO) (2011), IPIECA (2014b), and PREP (NRT, 2014), and build on the same basic principles. As there is no universal framework, not all common reference values or requirement levels can be used for comparison. Thus, some exercises are inherently self-evaluated and not all quantifiable measures can be compared between evaluation frameworks. It should therefore be encouraged to use one of the existing frameworks when conducting exercises. The goal-based evaluation is a common type of evaluation, and is used by MSB (MSB, 2010). It measures to what degree certain pre-designated targets have been met. Goal-based evaluations focus on the intended use and result of an exercise. Such an evaluation is best started with defining the aims of the exercise and relating the implementation and results of the exercise to these goals. The evaluation should relate both to the efforts of the involved personnel and whether the structure of the exercise has affected the possibility of reaching the exercise aims.

A successful exercise is an exercise and evaluation that manages to get the participants eager to want to learn more and improve their individual and organisational behaviour. After the exercise and evaluation, contingency plans have to be updated to reflect the lessons learned and subsequently tested in a new exercise cycle.

8.2 Methods

This chapter analyses the status of Swedish oil spill response and examines if the established measures maintain a sufficient response level for the oil spill risk.

Several measures contribute to whether an oil spill response is sufficient or not. Primarily, these relate to equipment, training, and exercises, but also include the lessons learned from real oil spills. Examining these factors determines their value for Swedish oil spill response.

8.2.1 Study design

The issues above are formalised into Hypothesis 4, H4:

H4 – Response measures are sufficient

Which gives the null hypothesis:

$H4_0$ – Response measures are insufficient

Hypothesis 4 was chosen to analyse whether oil spill response have sufficient equipment, training, and exercises, and issues discovered during real spills and exercises are systematically addressed. The units of analysis have been chosen based on reasoning and practicality after consulting literature and expert opinions.

Conducted training courses and participation determine the level of training among the organisations responsible for the oil spill response. The equipment location and inventory determine the available material resources. Conducted exercises, their frequency, methodology, and evaluations determine organisational and system learning. Outreach in order to learn and share information is determined by participation in external oil spill projects. The relationship between the units of analysis and their corresponding variables can be seen in Figure 45.

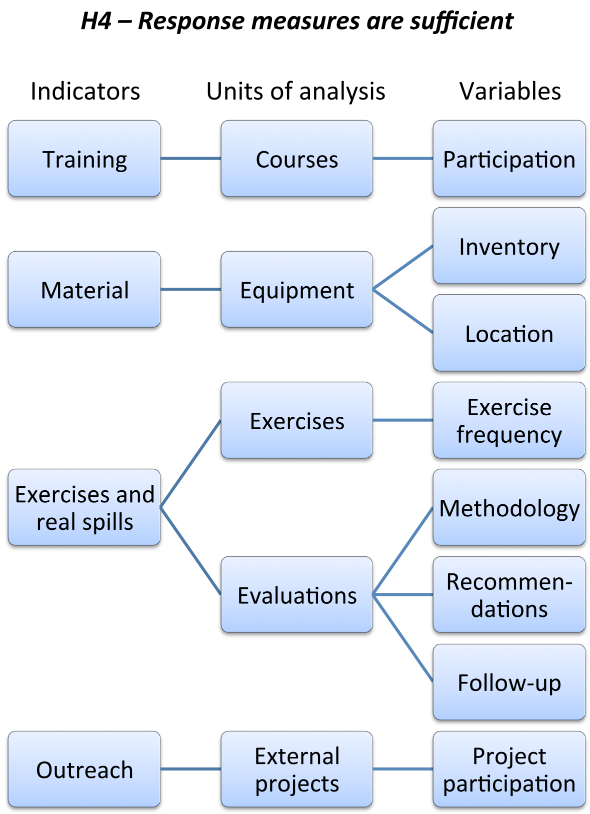

Figure 45: Hypothesis 4 chosen indicators, units of analysis, and variables.

For Sweden to have sufficient oil spill response measures, the municipalities would have to be properly trained and frequently conduct oil spill exercises, using equipment located close to the risk areas. A structured approach to working with identified oil spill response issues and engagement in external projects should also be evident.

These criteria have been quantified in Table 19 following to the reasoning for ranking the variables in Chapter 4.

Table 19: Evaluation criteria for H4.

	Preferable	*Sufficient*	*Insufficient*
Environmental impacts course	Representatives from 95% or more of the coastal municipalities have participated.	Representatives from 50% up to 95% of the coastal municipalities have participated.	Representatives from 95% or more of the coastal municipalities have participated.
Limitation and clean-up course	Representatives from 95% or more of the coastal municipalities have participated.	Representatives from 50% up to 95% of the coastal municipalities have participated.	Representatives from less than 50% of the coastal municipalities have participated.
Clean-up manager course	Representatives from 95% or more of the coastal municipalities have participated.	Representatives from 50% up to 95% of the coastal municipalities have participated.	Representatives from less than 50% of the coastal municipalities have participated.
Staff specialist course	Representatives from 95% or more of the coastal municipalities have participated.	Representatives from 50% up to 95% of the coastal municipalities have participated.	Representatives from less than 50% of the coastal municipalities have participated.
Land spills course	Representatives from 95% or more of the coastal municipalities have participated.	Representatives from 50% up to 95% of the coastal municipalities have participated.	Representatives from less than 50% of the coastal municipalities have participated.
Equipment inventory	Equipment quantified for regional and national use exist.	Equipment quantified for local and regional use exists.	Equipment quantified for local use does not exist.
Equipment location	95% or more of the equipment depots are located closer to major oil ports than before.	From 50% up to 95% of the equipment depots are located closer to major oil ports than before.	Less than 50% of the equipment depots are located closer to major oil ports than before.
Exercise frequency	95% or more of the municipalities held an oil spill exercise within the last 5 years.	From 50% up to 95% of the municipalities held an oil spill exercise within the last 5 years.	Less than 50% of the municipalities held an oil spill exercise within the last 5 years.
Evaluation methodology	95% or more of the examined evaluations use an established evaluation method.	From 50% up to 95% of the examined evaluations use an established evaluation method.	Less than 50% of the examined evaluations use an mentioned evaluation method.
Evaluation recommendations	95% or more of the examined evaluations gives recommendations.	From 50% up to 95% of the examined evaluations gives recommendations.	Less than 50% of the examined evaluations give recommendations.
Evaluation follow-up	95% or more of the examined evaluations requires follow-up measures.	From 50% up to 95% of the examined evaluations requires follow-up measures.	Less than 50% of the examined evaluations require follow-up measures.
Municipality external projects	95% or more of the municipalities have been partners in one or more external project.	From 50% up to 95% of the municipalities have been partners in one or more external project.	Less than 50% of the municipalities have been partners in one or more external projects.
CAB external projects	95% or more of the CABs have been partners in one or more external project.	From 50% up to 95% of the CABs have been partners in one or more external project.	Less than 50% of the CABs have been partners in one or more external projects.

These levels correspond to if a variable is wholly present and/or functioning (*Preferable*), partially present and/or functioning (*Sufficient*), or not present and/or functioning at all (*Insufficient*). All of the units of analysis will have to demonstrate that they at least reach the rank of *Sufficient* for H4 to be accepted, meaning that the oil spill response measures are sufficient, but should be further developed. If all variables are ranked *Preferable*, oil spill response measures are at the best practice level. If any of the variables are ranked *Insufficient*, important oil spill response measures are missing, negatively impacting Swedish oil spill preparedness.

8.2.2 Sources

Data were collected from publicly available sources online, primarily government websites. Response evaluations have been collected directly from the organisers or evaluators, if not publicly available. Scientific papers have been gathered through the library at the World Maritime University (WMU) and online open access journals. Project reports have been gathered from the project pages of various oil spill projects. Data on the MSB training courses was collected directly from the training unit at MSB.

Additional information and comments have been collected from the questionnaire (see Appendix A - Questionnaire) distributed to all coastal municipalities and CABs, and the interviews (see Appendix B - Interview) with the members of the National Cooperation Group for Oil Combating (NSO), described in Chapter 4.

8.2.3 Analysis

Different methods for analyses have been used in this chapter. The statistical analyses and graphs were generated using the GraphPad Prism statistical software. The statistical analyses used are Berger's test and X^2.

8.2.3.1 Evaluation analysis

The evaluation analysis used in this chapter follows the guidelines of Saunders (2012), ISO (2011), and IPIECA (2014b), and is built on the framework used by the Swedish Institute for the Marine Environment (Havsmiljöinstitutet, 2013) and MSB (2010). Using the above references as a template, an evaluation framework was constructed (see Appendix H - Response Results). The aim was to examine which analysis tools the Swedish oil spill evaluations have used, how the evaluations were done, what criteria were used for assessment, if and how the evaluations have been tied to plans or earlier evaluations, how the evaluations have been disseminated, and finally, how the recommendations have been followed up.

8.3 Results

Descriptive statistics and correlation testing have been used on the responses from the questionnaire. Two groups in the questionnaire were compared: the municipalities that have exercised their contingency plan and those that have not. These groups were tested with various influencing factors. An evaluation analysis was performed on a number of oil spill exercises and real oil spill evaluations.

8.3.1 Training

MSB have conducted 32 oil spill training courses up until the end of 2014 (see Figure 46).

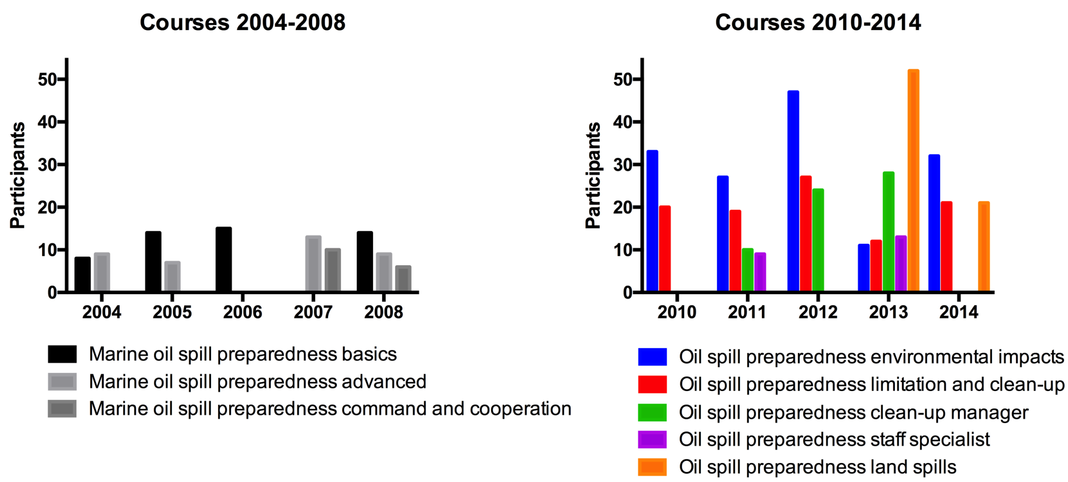

Figure 46: MSB oil spill preparedness courses.

A system of four oil spill preparedness courses: *Environmental impacts*, *Limitations and clean-up*, *Clean-up manager*, and *Staff specialist*, were introduced during 2010. In 2012, an additional course covering *Spills on land* was introduced. These courses replaced the old system of three courses that existed between 2004 and 2008: *Marine oil spill preparedness - Basic level*, *Advanced level*, and *Command and cooperation*. Both old and new courses have been arranged once a year in various cities around Sweden, with between 6 to 53 participants. However, 36% of the planned courses have been cancelled, with preregistration varying from 0 to 11, but in one instance reaching 20 participants.

The original courses had a total of 104 participants. Most were from the MSB Oil Spill Depots and participated in more than one course (see Table 20). However, no data detailing which depot the participants represented could be obtained. The basic level course was the most popular.

Table 20: MSB original course attendance.

	Basic level	Advanced level	Command and cooperation	Total
Participants	50	38	16	**104**

The modern courses have been attended by primarily municipality staff (84.4%), but also representatives from the Swedish Armed Forces (SAF), Swedish Maritime Administration (SMA), County Administrative Boards (CABs), ports, clean-up and oil companies representing the industry, the Swedish Sea Rescue Society (SSRS) representing volunteers, and other, for example academia an unaffiliated individuals (see Table 21). The *Environmental impacts* course is the most popular course. The course participants range from 147 on the *Environmental impacts* course, to 22 on the *Staff specialist* course. Only one individual has completed all the courses and another 10 individuals have completed four of the five courses.

Table 21: MSB course attendance by number of individuals.

	Environmental Impacts	Limitations and clean-up	Clean-up manager	Staff specialist	Spills on land
Agencies	6	5	2	1	5
CABs	5	1	1	0	3
Municipalities	124	80	53	21	60
Industry	6	9	4	0	3
Volunteers	2	1	0	0	0
Others	4	1	0	0	1
Total	**147**	**97**	**60**	**22**	**72**

Extrapolating the organisational affiliation of the participants, there are 57 municipalities represented among the participants for the *Environmental Impacts* course, down to 12 for the *Staff specialist* course (see Table 22). Only two of the CABs have participated in the courses.

Table 22: MSB courses attendance by number of organisations.

	Environmental Impacts	Limitations and clean-up	Clean-up manager	Staff specialist	Spills on land
Agencies	2	2	1	1	2
CABs	2	1	1	0	2
Municipalities	57	39	36	12	41
Industry	4	7	3	0	2
Volunteers	2	2	0	0	0
Others	3	1	0	0	1
Total	**70**	**52**	**41**	**13**	**48**

Extracting the affiliation of the participants and focusing on the 126 coastal municipalities, the participants represents at most two thirds of these municipalities or their Rescue Service Associations (see Table 23). Other landlocked municipalities are instead represented, particularly in the *Spills on land* course.

Table 23: Coastal municipality representation.

	Environmental Impacts	Limitations and clean-up	Clean-up manager	Staff specialist	Spills on land
Municipalities	88	65	61	29	56
Percentages	69.8 %	51.6 %	48.4 %	23.0 %	44.4 %

8.3.2 Equipment

No list of oil spill response equipment exists for all the Swedish municipalities. A summary of the resources available at the rescue services in the municipalities in northwestern Skåne, Blekinge, Gotland, and on the Danish island Bornholm was compiled for the Baltic Master II project (M. Olsson, 2012). The six involved Swedish municipalities had each between 175 and 750 m of boom, mostly around 400 m. Only one municipality had their own boat (although boats can usually be procured on short notice). None of the municipalities had any skimmers or pumps.

The CABs do not have any oil spill equipment, but most have access to boats or other vehicles.

On land, equipment is primarily stored at the five Oil Spill Depots and the central depot located around Sweden (see Figure 44). Relating to the largest oil ports in Sweden, two of the depots have been moved closer to one of the largest oil ports in Sweden, while three have been moved further away. This equipment is intended to supplement the municipalities and contains skimmers, quad motorcycles, beach cloth, and personal protection equipment (Kulander et al., 2004).

SCG has several kilometres of boom in their organisation and powerful skimmers and pumps onboard their vessels, as is the case with the other Baltic Sea Region countries (Pålsson et al., 2012).

Internationally, the European Maritime Safety Agency (EMSA), has three vessels in the area that are equipped with boom arms and skimmers and equipment stockpiles on land (EMSA, 2011). These vessels are on contract to be able to respond if needed, but otherwise fulfil other duties.

8.3.3 Exercise frequency

Extrapolating the municipality respondents to the 126 coastal municipalities they represent, 56 (44%) municipalities responded that they have used their oil spill contingency plan in an exercise and 35 (28%) that they had not used the plan in an exercise (see Table 24). Of the coastal municipalities, 35 (28%) did not respond.

Table 24: Questionnaire response rate for when the oil spill contingency plan was exercised.

Question	Answer	2011	2013	2015	Combined
When was the plan exercised?	0-5 years ago	29	37	56	72
	>5 years ago	9	3	0	3
	No exercise	56	41	35	45
	No reply	32	45	35	6

Combined with data from 2011 (Pålsson et al., 2011) and 2013 (Pålsson & Wåhlander, 2013), the total number of municipalities that have used their oil spill contingency plan in an exercise is 75 (60%) as of March 2015, with 72 (57%) having exercised within the last 5 years.

Combining the results of the questionnaire with previous data (Pålsson et al., 2011; Pålsson & Wåhlander, 2013), the number of municipalities that exercised their oil spill contingency plan during the preceding five years has almost doubled between 2011 and 2015 and the number of municipalities that have never used their plan decreased (see Figure 47).

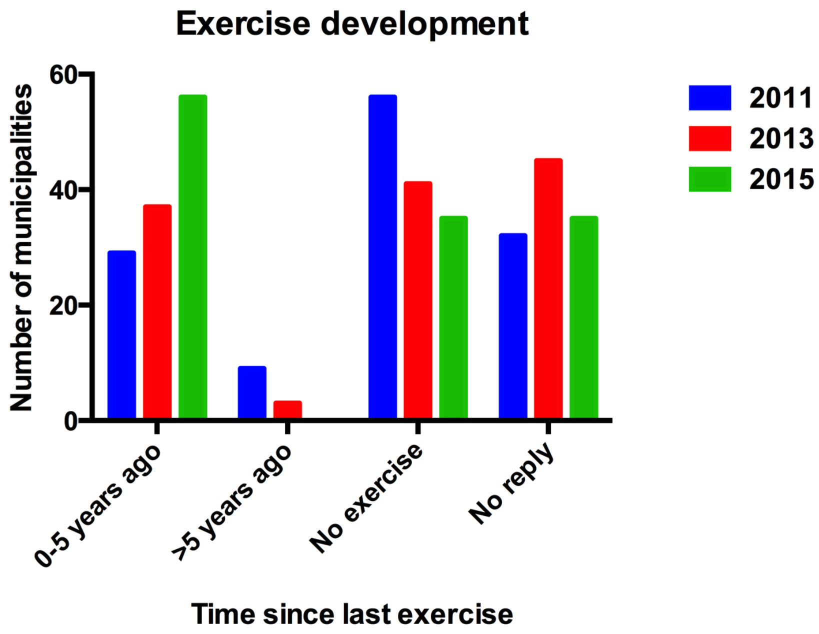

Figure 47: Time since last exercise the municipalities used their oil spill contingency plans.

There is a significant statistical difference between the years (excluding the "*No reply*" option, since it contains no information), X^2 (4, N = 126) = 23.24, p = .0001.

8.3.4 Evaluations

Two real oil spill evaluations (*Fu Shan Hai* 2003 and *Golden Trader* impacting Tjörn 2011) and nine oil spill exercises including at sea and onshore response to varying degrees (Matteus 2010, Skåne Nordväst 2010, Blekinge 2011, BOILEX 2011, Gotland 2011, Olivia 2011, FSHex13 2013, Barbro 2014, and Hedvig 2014) were analysed. These exercises represent the majority of the larger oil spill exercises that have been conducted between 2010 and 2015.

The analysis (see Appendix H - Response Results) showed that 77.8% of the 9 oil spill exercises follow the definition of functional exercises (ISO, 2011), but are mostly called tabletop exercises. Exercises were unique, one-off exercises, meaning that they were a first time occurrence, and not necessarily intended to be conducted regularly in 77.8% of the cases. Local municipalities have initiated most of the exercises and only the larger ones have been driven by state agencies. MSB guidelines (MSB, 2010) recommending both an internal and external evaluator were followed in 55.6% of the exercises.

Different methods, including no specific method, have been used for the 11 evaluations (exercises and the real spills) and 44.4% of these used an established evaluation method, defined as a named or documented method. Of the evaluations, 81.2% have evaluation criteria, but only 18.2% have measurable performance indicators. The data were mostly collected from documentation and evaluator notes, and 9.1% of the evaluations used questionnaires. Only 18.2% of the evaluations referred to older spills in the area and 27.3% to earlier evaluations, even though all of the locations have had one or several oil spills previously. The depth of the evaluations also differed substantially, with the shortest evaluation providing a 2-page summary and the most substantial evaluation being a thorough 131-page report. All evaluations have been summarised in a document, but 45.5% have also arranged one or several evaluation seminars to help to communicate the experiences from the exercises and real spills. A specific dissemination plan is included in 36.4% of the evaluations. Explicit recommendations were present in 72.7% of the evaluations, but only 18.2% required any follow up of the recommended measures.

8.3.5 External projects

Out of the 50 responding coastal municipalities, 13 responded that they had been part of an external oil spill project (26%). Of the 10 responding CABs, 4 responded that they had been part of an external project (40%).

There is no significant statistical difference for the responding coastal municipalities (see Figure 48 A) and responding CABs (see Figure 48 C), when correlating exercises and participation in external oil spill projects between 2010 and 2015, Berger's test ($N = 50$), $p = .076$ for (A) and ($N = 10$), $p = 1.000$ for (C).

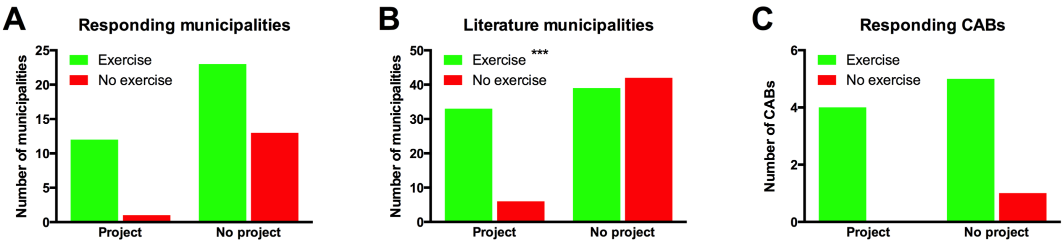

Figure 48: Project participation and exercises among municipalities responding to the questionnaire (A), taken from the project literature (B), and County Administrative Boards (CABs) responding to the questionnaire (C) between 2010 and 2015.

However, there is a significant statistical difference between project participation when combining data on exercises for all of the coastal municipalities (see Figure 48 B) who participated in the ARCHOIL, Baltic Master II, and EnSaCo oil spill projects, Berger's test (N = 120), p = .001.

8.4 Discussion

The evidence presented in the results is relevant for the future of Swedish oil spill response capability.

8.4.1 Training

Only 64% of the planned courses arranged by MSB have been completed, as some have been cancelled due to lack of interest. This may be because of participant scheduling conflicts when the courses are only held once per year, commitment to be away on a course for several consecutive days, a lack of awareness of the existence of the courses, or at worst, that previous participants have not recommended the course to their colleagues. In total, 147 individuals have taken the environmental impacts course, 97 the limitations and clean-up course, 60 the clean-up manager course, 22 the staff specialist course, and 97 the land spill course (see Figure 46). This shows a lack of specialist oil spill response training within the municipalities. Considering the 126 coastal municipalities and 18 coastal CABs, there is a 69.8% chance that a person in a municipality has specialised training on oil spills, a 51.6% chance to have someone specialised in limitations and clean-up, a 48.4% chance to have a certified clean up manager, a 23.0% chance to have someone certified as a command specialist, and a 44.4% chance to have someone specialised in oil spills on land. This assumes that the course participants have remained within their respective organisations. Of course, several individuals that have not taken any courses are still more than capable in these roles, for example because they are trained through other organisations than MSB or have experience with real spills. Many rescue service officers can utilise the general emergency protocols and adapt them to an oil spill, but they will lack critical knowledge of the unique characteristics of oil spills. Additionally, these few trained or experienced experts need work in shifts for the extended oil spill response operation during real spills. Therefore, several specialists are needed to be able to maintain the oil spill expertise during a response without fatigue setting in.

There has previously not been a fee for participating in the MSB-courses, other than travel and accommodation. However, due to economic cutbacks discussed in Chapter 6, the courses are subject to a fee from 2015 onwards. The fee ranges from 7,625 SEK, excluding VAT (~ 900 USD), up to 20,250 SEK, excluding VAT (~ 2,350 USD), and will likely mean that even fewer municipalities will consider sending their employees to these courses, as this is a substantial cost for most municipalities.

The courses have been setup nationally by MSB, and are not evaluated by any outside organisations, for example any of the international oil spill organisations (Källström, H., email communication, 25 May 2015).

8.4.2 Equipment

The five Oil Spill Depots managed by MSB were set up after a Swedish project programme called Teknik for oljebekämpning till sjöss samt bekämpning och sanering av olja i strandzonen (TOBOS) in the 1980s, aimed to increase the preparedness after the *Tsesis* oil spill. After the initial creation, the inventory has been replaced and items have been removed or added over time (Ericsson, M., email communication, 18 Sep 2015).

The Baltic Master II report (M. Olsson, 2012) highlights the lack of oil spill equipment at the municipal level, and emphasizes their dependence and reliance on the Oil Spill Depots for specialised oil spill response equipment, such as skimmers. However, exercise and real spill evaluations show that the amount of oil spill equipment has not been deemed a limiting factor for Swedish oil spill response (Dimming, 2012; Holmström et al., 2014; Kustbevakningen et al., 2010; Martinsson & Fejes, 2007; MSB, 2012; MSBHaV, 2014). Between SCG, the Depots, and procured equipment, there has never been any problem to acquire resources during a Swedish oil spill response (excepting that some sellers increases their prices). However, it should be noted that certain specialised equipment was missing during *Fu Shan Hai* and Tjörn, especially for the voluntary oiled wildlife responders (Edelius, M., personal communication, May 2014). But as the oiled wildlife is not an official part of the response, no resources were allocated to fill this gap. Today, oiled wildlife responders are better equipped with tents and cleaning facilities.

Experience from the *Deepwater Horizon* oil spill in the United States in 2010 showed that large amounts of equipment in the form of booms and protective gear could be swiftly procured and shipped to the location of the spill (Allen, 2010). However, with no prior agreements, prices skyrocketed. Additionally, procedures for accepting equipment and aid from abroad proved to be problematic during the *Deepwater Horizon* (Allen, 2010), which was also the Swedish experience from the BOILEX exercise, when procedures for accepting equipment from Finland, Russia, and Estonia were tested (MSB, 2012).

The recent move of the Oil Spill Depots may both increase and decrease response times. On the west coast, the two largest oil ports, Gothenburg and Brofjorden Preemraff, annually handle around 20 million tonnes of oil each. This is far above the third largest port, Malmö, that handle 3 million tonnes (Göteborgs Hamn, 2015). Since the previous location of the west coast Depot was in Vänersborg, on the coast of lake Vänern, the move to the port of Gothenburg is a more strategic location due to the intense traffic and large volumes of oil being transported on the west coast. As the central MSB depot remains in Kristinehamn, on the coast of Vänern, there is still equipment close by this lake. No larger oil spill has been recorded in the Swedish great lakes, but as these are major sources of drinking water for large cities in Sweden, they are of particular strategic importance. For example, a catastrophic spill in Mälaren would disrupt the drinking water supply to the Stockholm region, consisting of around 2 million people. However, the Depot move from Karlskrona in the southeast to Oskarshamn is surprising, given that an oil spill occurred in Karlskrona in 1990 and that the Blekinge archipelago is a protected area, highly vulnerable to oil spills because of the many small islands. As the Depots can easily be loaded onto trucks and carried by road to the spill sites, swift access to larger highways also has a significant impact on the deployment times.

Additionally, this move excludes the rescue service personnel trained on the equipment at the previous locations. The personnel will instead be part of the established MSB resource pool. This pool lists suitably trained personnel that can, on short notice, be sent to an oil spill, to be in charge of the equipment and training of staff on the use of the equipment. However, it is unsure how many people will be listed in the pool, if the members of the resource pool are in fact available in sufficient numbers when called upon, and how maintenance and training on the equipment will work.

8.4.3 Exercises

For a response to work as best as possible, a feeling of trust and respect among the involved organisations must exist (Meyerson, Weick, & Kramer, 1996; Ödlund, 2010; Purnell & Zhang, 2014). However, these feelings may disappear quickly during a real response. Stress, fatigue, accident investigations, and potential litigation can cause individuals to become guarded and less trusting. It is often the case that once the immediate emergency has been dealt with, sides begin to emerge and blame for inevitable mistakes will be assigned. The *Deepwater Horizon* response is a good example of this, where the media immediately portrayed BP as the culprit in the disaster, undermining much of the needed cooperation and trust that the responders needed to have with the industry (Allen, 2010). Media management is therefore of crucial importance. Real cooperation can only exist when everyone involved are working towards the same transparent goals, without any ulterior motive. One way to foster this desired cooperation is through exercises with fictional, but realistic, scenarios. Exercises also provide opportunities for the authorities responsible for oil spill preparedness to report the results, ideas, and work with the oil spill community to further improve the response capabilities. It is thus encouraging to see the increase in municipal exercises between 2010 and 2015 (see Figure 47). However, there are still geographic and topical gaps identified in the evaluations (see Appendix H - Response Results) that should be addressed.

The most interesting result of this study is that exercises are closely associated with the EU oil spill projects examined (see Figure 48). This suggests that an important driving factor, involved in almost half of the exercises conducted during the last 5 years, is participation in external oil spill projects. Project participation has functioned as incentives and helped municipalities to exercise their plans. However, exercises should ideally be an integral part of the organisations' work. Exercises should only be supplemented by the EU projects, the projects should not constitute the only reason for conducting exercises. As the oil spill projects have ended, this may lead to a decrease in oil spill exercises. MSB has a role to play here, as the agency is responsible for coordinating disaster response and to train and exercise the civil defence (Regeringen, 2008b). It would be helpful for the national oil spill response if the government or MSB clearly establishes exercise requirements, similar to what the United States has established through the PREP programme (NRT, 2014). This intention is acknowledged in the draft action plan (NSO, 2015) for the Swedish Strategy for Oil Spill Preparedness (NSO, 2014b).

The exercises examined in this chapter have been structured as completely new events in 7 out of 9 cases and rarely consider the context of the involved organisation

(MSB, 2010). This makes the evaluations a critical point to transfer the knowledge gained from one exercise or real spill to the next. Experienced individuals may quit or move to another position, and the organisation may thus loose unique knowledge from exercises or real spills. The experiences gained from an exercise must be addressed for organisational learning to come into effect, for example through documentation and follow-up. Evaluations can be done at different levels, but it is important that the evaluation is as honest as possible (Purnell & Zhang, 2014). Many incident evaluations are biased by fear of reprisal or for political reasons, for example in the form of getting bad press or to appear more successful to superiors or auditors, in order to avoid further investigations. Consequently, they are written in a positive tone and may make unsubstantiated conclusions about success of the exercise of real response, giving the false impression that there were no issues. Care must also be taken when developing scenarios for oil spill exercises. Making the scenario too easy can invoke a false sense of security, and making it too hard may lead to a chaotic exercise and diminished enthusiasm from the participants.

A significant problem is the few evaluation structures for oil spill response. Evaluation tools for exercises exists, for example the mentioned PREP guidelines in the United States (NRT, 2014). However, these are usually tailored for national requirements or specific industries and are hard to adapt to regulations in another country. Few exercise structures mean that there are few indicators that are possible to compare between exercises. In some cases, there might be some objective performance data from the last exercise, for example time before notification of all stakeholders was done or time before a command centre was established. If the scenarios and evaluations were the same between exercises, numbers and performance objectives could be compared. Of course, this has both advantages and disadvantages, especially considering how different the coastal municipalities are. While some municipalities only have a few hundred meters of coast, others have several tens of kilometres and hundreds of islands, which make the priorities and consequently the resources spent on oil spill response quite diverse among municipalities. More information can also be gathered from conducting exercises. Systematic inquiries, for example through administering questionnaires before and after the exercises, can estimate the exercise effects on the participants. However, it is apparent from the evaluations analysed that the participants generally think that the exercises were good and that they sincerely appreciated them. The evaluations especially reflect the positive effect that the exercises have for the onshore organisations by increasing knowledge about oil spills and other organisations and building the trust and connections discussed in Chapter 5.

The survey responses indicate that the municipalities (see Figure 49 A) and CABs (see Figure 49 B) would like to have a tabletop exercise every 2 to 5 years and the agencies (see Figure 49 C) would like to have an exercise every 1 to 3 years.

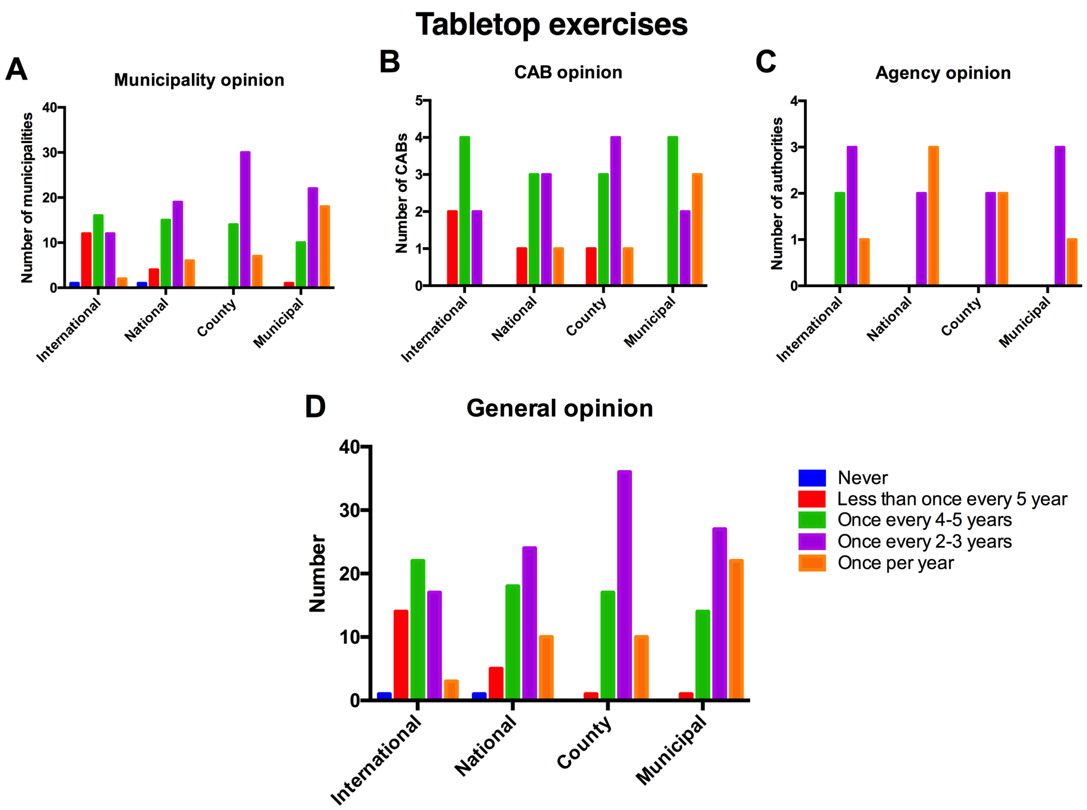

Figure 49: Opinions from the municipalities (A), County Administrative Boards (CABs) (B), agencies (C), and combined (D) on the frequency of tabletop exercises.

The respondent consensus is that municipal, county, and national tabletop exercises should be conducted once every 1 to 3 years, with a greater proportion preferring a municipal exercise every 2 to 3 years.

Results for deployment exercises, corresponding to the ISO definition of Full-scale exercises (ISO, 2011), indicate that municipalities prefer these once every 2 to 5 years for most levels, while CABs and agencies prefer the exercises once every 4 to 5 years (see Figure 50).

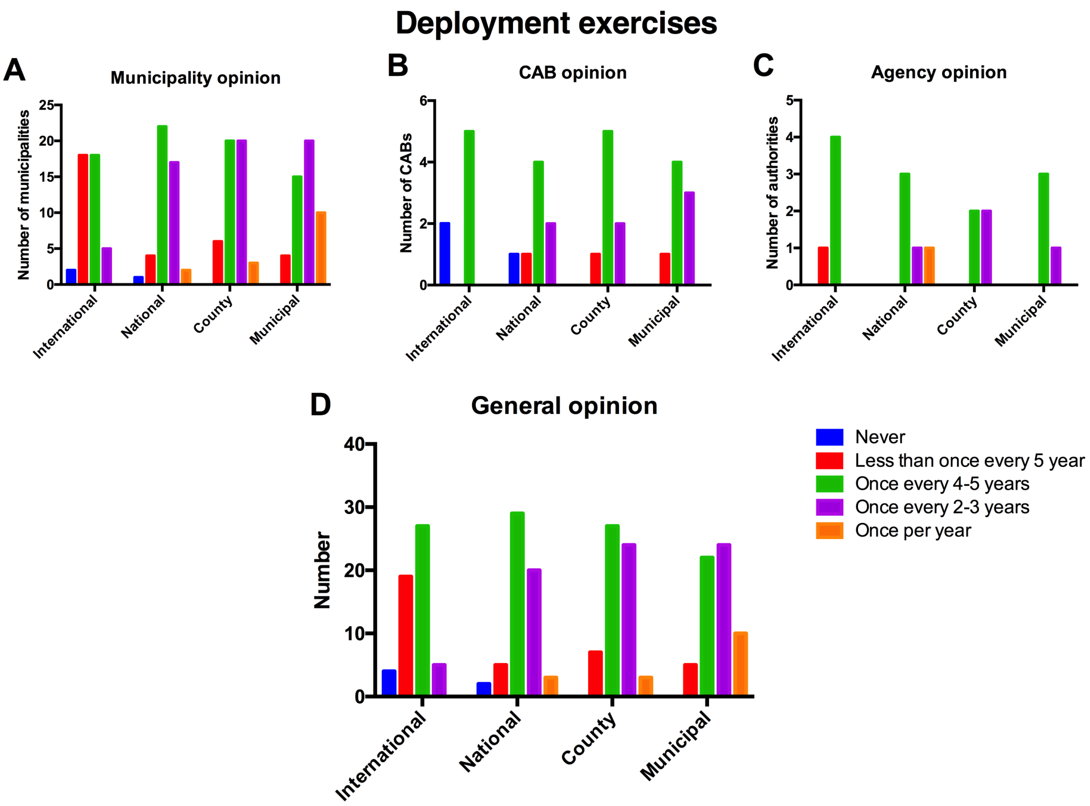

Figure 50: Opinions from the municipalities (A), County Administrative Boards (CABs) (B), agencies (C), and combined (D) on the frequency of deployment exercises.

The consensus is that international onshore deployment exercises should be held once every 4 to 5 years or longer, and national, county and municipal exercises should be held once every 2 to 5 years.

The recommended exercise frequency should be taken into account when next reviewing the national exercise system. At the time of writing, the Swedish exercises are very few onshore, while SCG regularly participate in both minor (for example municipal or port exercises) and major oil spill exercises at sea (for example BALEX DELTA or the Copenhagen Agreement exercises) during the year (Kustbevakningen, 2013a; 2014; 2015). Taking the financial aspects into account, as the measures should be cost effective, a municipal tabletop exercise is the best option in some cases, while a full-scale exercise is needed in other cases, depending on risk and resources at disposal. Another point when discussing the frequency is how often you need to exercise to maintain the expertise compared to when you are building expertise. Reasonably, the learning curve is generally steep in the beginning, if going from no knowledge to some knowledge, and then levels out. When having exercised up to a certain level, the frequency of exercises could be decreased, without losing response quality. Additionally, appropriate staff should be sent abroad as participants or observers during international oil spills or exercises. Such transfer of knowledge could be very useful for maintaining the necessary response quality.

However, a PREP-like system is of course not a panacea. The critique that has been discussed here for the evaluations, has been discussed within the PREP community as well (Cashman, 2005; Reiter et al., 2005). A major point has been the stagnation of the PREP exercises, which should optimally continuously build on lessons learned from the previous year and continuously test new issues, but are not as good in reality. This is an inherent problem of having a standardised scenario. However, looking at the Swedish situation, a standardised scenario would be a positive start in order to increase the preparedness.

8.4.4 Implications

Response issues have primarily been found in the response organisations onshore, as SCG have demonstrated frequent training and exercises for the response at sea.

The discussion repeatedly comes back to the need for an authority to set requirements for training and exercises on land. There should also be an organisation able to assist the municipalities in preparing for and evaluate the exercises, develop a standard scenario with performance indicators, a standardised evaluation system, and a system for following up the recommendations and lessons learned from exercises and real spills. MSB would be the most logical authority for this, as they already have oil spill, training, exercise, and evaluation expertise.

The response at sea is regulated in several international conventions and agreements, discussed in Chapter 6. However, few international agreements exist on oil spill response onshore. For Sweden, the most relevant agreement would be the *HELCOM Manual on Co-operation in Response to Marine Pollution within the framework of the Convention on the Protection of the Marine Environment of the Baltic Sea Area (Helsinki Convention)* (HELCOM, 2013a). The 2013 addition of Volume III to this manual specifically addressed onshore response, but primarily regulated international cooperation, for example requests for international assistance, cross-border movement of personnel and equipment, customs procedures, and logistics (HELCOM, 2013b). However, an important section is the addition of a shoreline component to the annual HELCOM BALEX DELTA oil spill exercises, although this is not mandatory for every BALEX DELTA exercise.

The scores of the analysed variables for oil spill planning in this chapter have been summarised in Table 25.

Table 25: Scores for the H4 variables.

	Preferable	*Sufficient*	*Insufficient*	Score
Environmental impacts course	Representatives from 95% or more of the coastal municipalities have participated.	Representatives from 50% up to 95% of the coastal municipalities have participated.	Representatives from 95% or more of the coastal municipalities have participated.	**69.8%**
Limitation and clean-up course	Representatives from 95% or more of the coastal municipalities have participated.	Representatives from 50% up to 95% of the coastal municipalities have participated.	Representatives from less than 50% of the coastal municipalities have participated.	**51.6%**
Clean-up manager course	Representatives from 95% or more of the coastal municipalities have participated.	Representatives from 50% up to 95% of the coastal municipalities have participated.	Representatives from less than 50% of the coastal municipalities have participated.	**48.4%**
Staff specialist course	Representatives from 95% or more of the coastal municipalities have participated.	Representatives from 50% up to 95% of the coastal municipalities have participated.	Representatives from less than 50% of the coastal municipalities have participated.	**23.0%**
Land spills course	Representatives from 95% or more of the coastal municipalities have participated.	Representatives from 50% up to 95% of the coastal municipalities have participated.	Representatives from less than 50% of the coastal municipalities have participated.	**44.4%**
Equipment inventory	Equipment quantified for regional and national use exist, counted as 100%.	Equipment quantified for local and regional use exists, counted as 50%.	Equipment quantified for local use does not exist, counted as 0%.	**100.0%**
Equipment location	95% or more of the Depots are located closer to major oil ports than before.	From 50% up to 95% of the Depots are located closer to major oil ports than before.	Less than 50% of the Depots are located closer to major oil ports than before.	**40.0%**
Exercise frequency	95% or more of the municipalities held an oil spill exercise within the last 5 years.	From 50% up to 95% of the municipalities held an oil spill exercise within the last 5 years.	Less than 50% of the municipalities held an oil spill exercise within the last 5 years.	**60.0%**
Evaluation methodology	95% or more of the examined evaluations use an established evaluation method.	From 50% up to 95% of the examined evaluations use an established evaluation method.	Less than 50% of the examined evaluations use an established evaluation method.	**45.4%**
Evaluation recommendations	95% or more of the examined evaluations give recommendations.	From 50% up to 95% of the examined evaluations give recommendations.	Less than 50% of the examined evaluations give recommendations.	**72.7%**
Evaluation follow-up	95% or more of the examined evaluations require follow-up measures.	From 50% up to 95% of the examined evaluations require follow-up measures.	Less than 50% of the examined evaluations require follow-up measures.	**18.2%**
Municipality external projects	95% or more of the municipalities have been partners in one or more external project.	From 50% up to 95% of the municipalities have been partners in one or more external project.	Less than 50% of the municipalities have been partners in one or more external projects.	**26.0%**
CAB external projects	95% or more of the CABs have been partners in one or more external project.	From 50% up to 95% of the CABs have been partners in one or more external project.	Less than 50% of the CABs have been partners in one or more external projects.	**60.0%**

As shown by analysis of the variables in Table 25, several are ranked as *Insufficient*. This indicates that the municipal participation is low in the courses, regional equipment exists but has just been relocated further away from the larger oil ports, not all Swedish municipalities have exercised, no common exercise evaluation for oil spills is used or enforced, the recommendations and lessons learned are not followed up, and the conducted exercises are to a large extent opportunistic events funded by temporary EU projects. Therefore, the hypothesis:

H4 – Response measures are sufficient

is rejected and the null hypothesis $H4_0$ is accepted. This situation does not seem to be as optimistic as the planning development, as the exercises are generally not conducted without additional push from external projects and are not systematically evaluated and followed-up.

8.4.5 Limitations

The same statistical limitations as for the planning apply to the response and the exercise data. However, the correlation found between being part of EU projects and exercises is very strong (see Figure 48). The questionnaire data are in general supported by the literature and interview data. There are also oil spill exercises that have been mentioned in the questionnaire responses, but which were not part of the evaluation analysis. This is primarily because those exercise evaluations have not been possible to access.

8.5 Conclusions

As shown in this chapter, most of the municipalities have little or no training and experience from real spills or exercises. The questionnaire responses show that regions that have been impacted by, and are more at risk from, oil spills are generally better prepared. Depending on where a municipality is located and its exposure to oil spill risk, it may be more cost-efficient to scale the preparedness accordingly. This will develop needs for training, equipment, and exercises relevant to the local situation.

The Swedish Civil Contingencies Agency is responsible for the five regional Oil Spill Depots and for coordinating oil spill preparedness nationally. The municipalities are requested to have a basic supply of equipment and preparedness, but equipment has not been a limiting factor during the last larger oil spill responses, *Fu Shan Hai* and Tjörn. However, the municipalities rely to a large extent on the equipment in the Oil Spill Depots, some even exclusively.

In contrast to the authorities at sea, it is difficult for many municipalities to regularly exercise their oil spill contingency plans. Results indicate that external projects have been an influential driver in conducting oil spill exercises in Sweden. Exercises should be conducted regularly at municipal, county, and national level, to safeguard that the gathered knowledge and expertise will not be forgotten. A simple tabletop exercise takes no more than a day to perform. Exercises also develop personal relationships, which are important during response. Complex operations are thus of relevance to exercise regularly, not exclusively oil spill exercises. The responsibility to oversee training requirement and implement exercises has been firmly lifted to the County Administrative Boards in the draft action plan tied to the new Swedish Strategy for Oil Spill Preparedness. This is a welcome development, acknowledging the need to implement requirements regarding training, exercise frequency, and evaluation methodology, to improve the currently insufficient oil spill response measures in Sweden.

Chapter 9 - International Practice

The fifth and final of the results chapters compares Swedish oil spill preparedness to international practice. It quantifies selected measures and uses a standardised evaluation tool to compare countries around Sweden.

9.1 Introduction

Oil spill preparedness has developed significantly from the first oil spill up to the present day, but still varies between countries. For example, use of contingency plans for oil spill preparedness was rare until the 1950s (ITOPF, 2012a). As the awareness of the risks and the impacts of oil spills grew, more and more countries established legal requirements and developed contingency plans. This often happened in the wake of a well publicised oil spill, for example the Oil Pollution Act of 1990 (OPA90) in the United States after the *Exxon Valdez* oil spill in Alaska 1989 (USC, 2000). The sophistication of the plans grew over time, as regulators and response planners gained experience. The value of exercises to test the preparedness has been increasingly recognised. As competency in a specific oil spill response topic grows, new topics could be explored and tested. A good example of this is waste management. In the early days of oil spill response, the first priority was more focused on the speed of the oil spill recovery (ITOPF, 2012a). This had the effect that the waste from the oil spill response accumulated faster than it could be taken care of. Raised awareness of this issue resulted in better preparation of waste segregation and disposal procedures in subsequent response operations. Development and maintenance of oil spill preparedness is closely regulated in many nations. The content of oil spill contingency plans, training standards, exercise types and frequency, are now usually well defined. However, in some nations, oil spill contingency plans and response capabilities may be missing completely. This might be due to lack of appropriate expertise or funding. In such circumstances, it is common for the local operators of oilrigs, pipelines or ports to look for the best international practices. In many nations, the responsibility to build oil spill preparedness has been laid exclusively on the oil industry, and not on other sectors that handle or transport oil (Taylor, Steen, Meza, Couzigou, Hodges, Miranda, Ramos, & Moyano, 2008a), including some national governments. Consequently, the industries' oil spill preparedness in a country does not necessarily reflect the national preparedness.

There are few formal frameworks designed to assess the full range of oil spill preparedness activities, from plan development, implementation, response equipment, training, and preparedness sustainability, and to which assessments can be compared (Taylor, Steen, Meza, Couzigou, Hodges, Miranda, Ramos, & Moyano, 2008b).

As the interest in assessing performance of oil spill preparedness has grown, many expert organisations have published guidelines. For example, the International Organization for Standardization (ISO) has published general guidelines for exercises and testing (ISO, 2011), the International Maritime Organization (IMO) has published manuals on oil pollution concerning prevention (IMO, 2011), contingency planning (IMO, 1995), oil combating (IMO, 2005), and administration (IMO, 2009), and the International Oil Spill Conference (IOSC) has published RETOS™, an international tool to assess oil spill response planning and readiness (Taylor et al., 2014; Taylor & Lamarche, 2014). From the industry side, organisations such as the American Petroleum Institute (API), the International Tanker Owners Pollution Federation (ITOPF), and the International Petroleum Industry Environmental Conservation Association (IPIECA) have published numerous guides and reports on oil spill preparedness issues (API, 2013a; 2013c; 2013e; IPIECA, 1994a; 2004a; 2004b; ITOPF, 2011d; 2011b; 2011c). Several projects have been setup to disseminate these guidelines and train national authorities and companies, for example the Global Initiative (GI), the Regional Maritime Pollution Emergency Information and Training Center for the Wider Caribbean

Region (RAC/REMPEITC-Caribe), and the Project on Oil Spill Preparedness and Response in the ASEAN Seas Area (ASEAN-OSPAR Project).

A concept of categorising the different levels of oil spill preparedness and response, called the Tiered Preparedness and Response, is included in many of the guidelines used internationally (IPIECA, 2007). It was developed in the 1980s by the oil spill industry to facilitate the structuring of the response with an appropriate amount of resources, which can be mobilised rapidly and escalated if needed. The Tiered Preparedness and Response categorises oil spill incidents according to their severity and the needed response capabilities. The concept is a function of size and location and is most commonly divided into three tiers (see Figure 51).

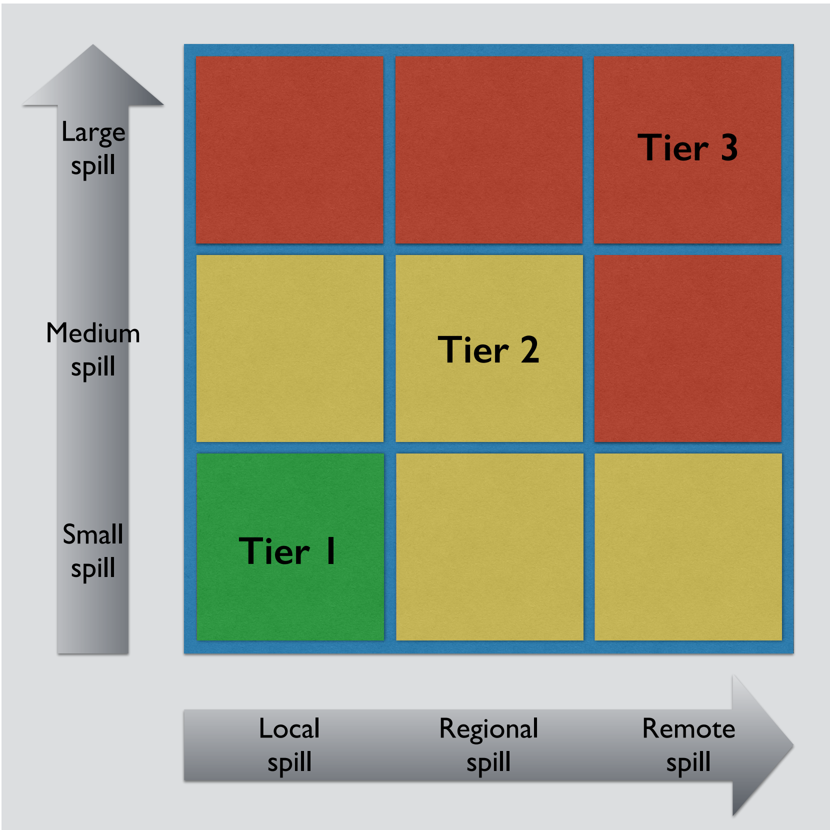

Figure 51: Concept of Tiered Preparedness and Response, depending on spill size and proximity, adapted from the IPIECA (2007) model.

- Tier 1 spills are small spills mostly in or near the operator's own facilities and are often operational in nature (e.g. tank overflow when lightering or leaking hoses or valves). The operator is expected to maintain equipment and trained personnel to respond to these spills without involving the government.

- Tier 2 spills are larger and extend outside of the operator's facilities or jurisdiction. The resources of the operator are insufficient to handle a Tier 2 spill and outside assistance is needed.

- Tier 3 spills are major spills that require resources from the whole nation and may even require international assistance.

However, in practice, there are many factors that will influence the needed response and the limits of the different tiers (IPIECA, 2007). Factors such as availability of personnel and equipment, infrastructure, spill site accessibility and logistics, can all move the definition of the tier levels around. This is also the reason no specific oil spill weight or volume is tied to the different Tiers.

The *"best international practice"* for oil spill preparedness is not a single manual, but a compilation of guidelines and recommendations for certain aspects of the oil spill response management system or the system specific to a certain country (Cashman et al., 2003; Taylor, Steen, Meza, Couzigou, Hodges, Miranda, Ramos, & Moyano, 2008a). However, the IOSC Guidelines and RETOS™ propose the most comprehensive compilation of topics that has been found (Taylor, Steen, Meza, Couzigou, Hodges, Miranda, Ramos, & Moyano, 2008b). These guidelines and tools try to create a consistent and broad international guide for spill response planning and readiness assessment. They have been developed and refined over several years, and tested in a number of different countries in the Americas (RAC-REMPEITC, 2015; Taylor et al., 2014; Taylor & Lamarche, 2014).

9.2 Methods

Chapter 9 analyses international oil spill preparedness measures and compares them to those used in Sweden. Several indicators can be used to compare the level of oil spill preparedness among countries. However, these indicators must be standardised as much as possible, logically making those that can be objectively quantifiable preferable to use.

9.2.1 Study design

The issues described above have been formalised as Hypothesis 5, H5:

H5 – Preparedness in Sweden is equivalent to international practice

Which gives the null hypothesis:

$H5_0$ – Preparedness in Sweden is not equivalent to international practice

Hypothesis 5 was chosen to analyse Sweden compared to international practices on ratification of conventions and oil spill preparedness measures. The units of analysis have been chosen based on reasoning and practicality after consulting literature and expert opinions.

The number of oil spill conventions ratified determines the international political commitment. The oil spill preparedness target values determine the level of ambition of the different nations. The use of National Contingency Plans and the Tiered Preparedness and Response concept determine the international practice. The RETOS™ evaluation determines the oil spill preparedness level of different nations. The relationship between the units of analysis and their corresponding variables can be seen in Figure 52.

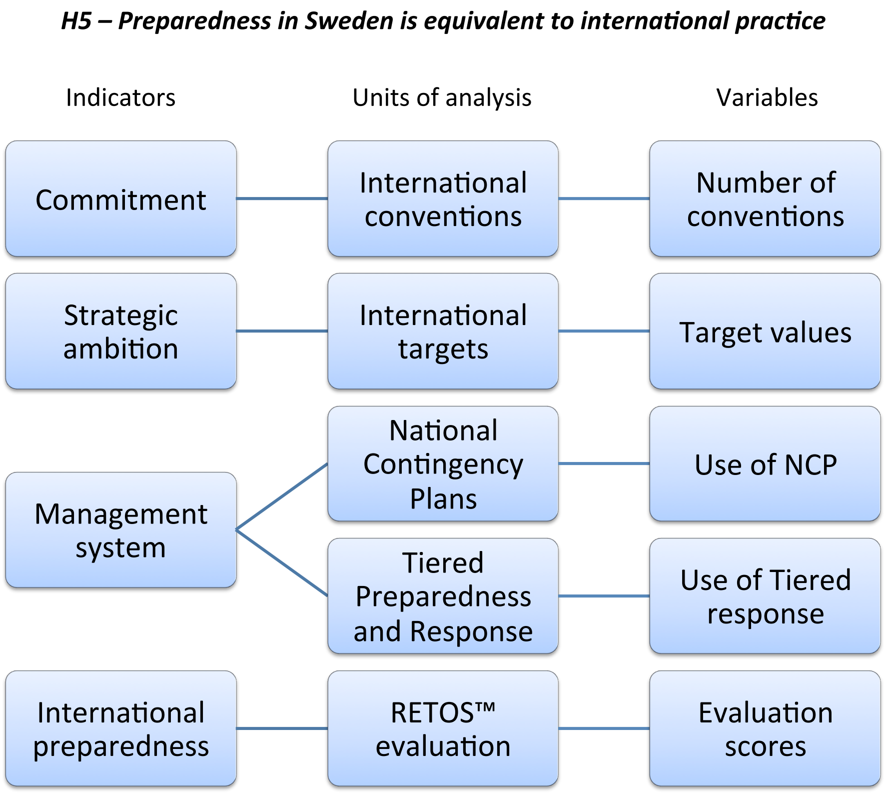

Figure 52: Hypothesis 5 chosen indicators, units of analysis, and variables.

If Sweden has ratified the relevant international conventions, use Tiered Preparedness and Response, has an oil spill preparedness target value in line with international practice, has a National Contingency Plan, and has a comparable RETOS™ evaluation score with the neighbouring countries, the preparedness would be considered equivalent to international practice.

These criteria have been quantified in Table 26, following the reasoning for ranking the variables in Chapter 4.

Table 26: Evaluation criteria for H5.

	Preferable	*Sufficient*	*Insufficient*
Number of conventions	Sweden has ratified a number of conventions more than one standard deviation from the average, equal to more than 87.0%.	Sweden has ratified a number of conventions within +/- one standard deviation from the average, equal to between 16.6% and 87.0%.	Sweden has ratified a number of conventions less than one standard deviation from the average, equal to less than 16.6%.
Target value	Sweden has oil spill preparedness targets higher than 95% or more of the neighbouring countries.	Sweden has oil spill preparedness targets higher than 50% up to 95% of the neighbouring countries.	Sweden has oil spill preparedness targets lower than 50% of the neighbouring countries.
Use of NCP	Sweden follows international practices by having a National Contingency Plan, counted as 100%.	Sweden does not follow international practices, but has a system equivalent to a National Contingency Plan, counted as 50%.	Sweden does not follow international practices by having a National Contingency Plan, counted as 0%.
Use of Tiered response	Sweden follows international practices by using Tiered Preparedness and Response, counted as 100%.	Sweden does not follow international practices, but uses a system equivalent to Tiered Preparedness and Response, counted as 50%.	Sweden does not follow international practices by using Tiered Preparedness and Response, counted as 0%.
Evaluation scores	Sweden scores more than one standard deviation from the average score of the compared countries, equal to more than 85%.	Sweden scores within +/- one standard deviation from the average score of the compared countries, equal to between 61% and 85%.	Sweden scores less than one standard deviation from the average score of the compared countries, equal to less than 61%.

These levels correspond to if a variable is higher than average, average, or below average. All of the units of analysis will have to demonstrate that they at least reach the rank of *Sufficient* for H5 to be accepted, meaning that Swedish oil spill preparedness is equivalent to other countries, but should be further developed. If all variables are ranked *Preferable*, Swedish oil spill preparedness is at the best practice level. If any of the variables are ranked *Insufficient*, certain oil spill preparedness measures are missing, compared to other countries.

9.2.2 Sources

Data was collected from publicly available sources online, primarily government websites. Project reports have been gathered from the project pages of various oil spill projects. Data from the RETOS programme has been gathered from country representatives, primarily the responsible oil spill agencies in the Baltic Sea area, the United States, and Norway. The Baltic Sea countries and Norway were chosen as they represent the neighbouring countries and the United States is used as a reference country. Scientific papers have been gathered through the library at the World Maritime University (WMU) and online open access journals.

Additional information and comments have been collected from the interviews (see Appendix B - Interview) with the Swedish National Cooperation Group for Oil Combating (NSO), described in Chapter 4.

9.2.3 Analysis

Different methods for analyses have been used in this chapter. The statistical analyses and graphs were generated using the GraphPad Prism statistical software. The statistical analyses used are Berger's test, Friedman's test, and Dunn's post test.

9.2.3.1 Convention analysis

The assessment of ratified IMO Conventions and Protocols assigned the value 1 to each and then added them to form a sum between 0 and 12. For this analysis, denounced Conventions and Protocols have been rated as 1, as they were once ratified. This analysis does not include any assessment of implementation or enforcement of these Conventions and Protocols.

9.2.3.2 RETOS™ programme

The RETOS™ programme has been used for the standardised comparison. It is an Excel tool based on original work developed for the ARPEL Governance Project (AGP) and refined for the International Oil Spill Conference between 2008 and 2014 (Taylor et al., 2014; Taylor & Lamarche, 2014; Taylor, Steen, Meza, Couzigou, Hodges, Miranda, Ramos, & Moyano, 2008a; 2008b). RETOS™ provides a general guide for industry and governments to assess their level of oil spill response, planning, and readiness management in relation to established criteria, and is intended for international best management practices. Many regional and international experts from industry and government support RETOS™, for example IMO, Clean Caribbean and Americas (CCA), the Regional Activity Center - Regional Marine Pollution Emergency Information and Training Center for the

Wider Caribbean (RAC/REMPEITC-Caribe), Oil Spill Response Limited (OSRL), Caspian and Black Sea's Oil Spill Preparedness Regional Initiative (OSPRI), the Global Initiative West and Central Africa (GI WACAF), and IPIECA. The chosen countries have all been analysed using the National RETOS Level A part of the RETOS™ Programme, evaluating the basic and most important aspects of national preparedness. The B and C levels go further into details of the preparedness and assume that Level A is passed. Levels B and C have not been used for the comparison, as most countries did not pass the Level A evaluation.

9.3 Results

The results compare international practice with Swedish oil spill preparedness.

9.3.1 International conventions

As described in Chapter 3, there are several international IMO Conventions and Protocols that concern oil spill preparedness. These are MARPOL 73/78 Annex I/II, Intervention Convention 69, Intervention Protocol 73, CLC Convention 69, CLC Protocol 76 and 92, FUND Convention 71, FUND Protocol 76, 92 and 03, OPRC Convention 90, and Bunker Convention 01. The sum of these ratified conventions and protocols (IMO, 2015c) was mapped in Figure 53.

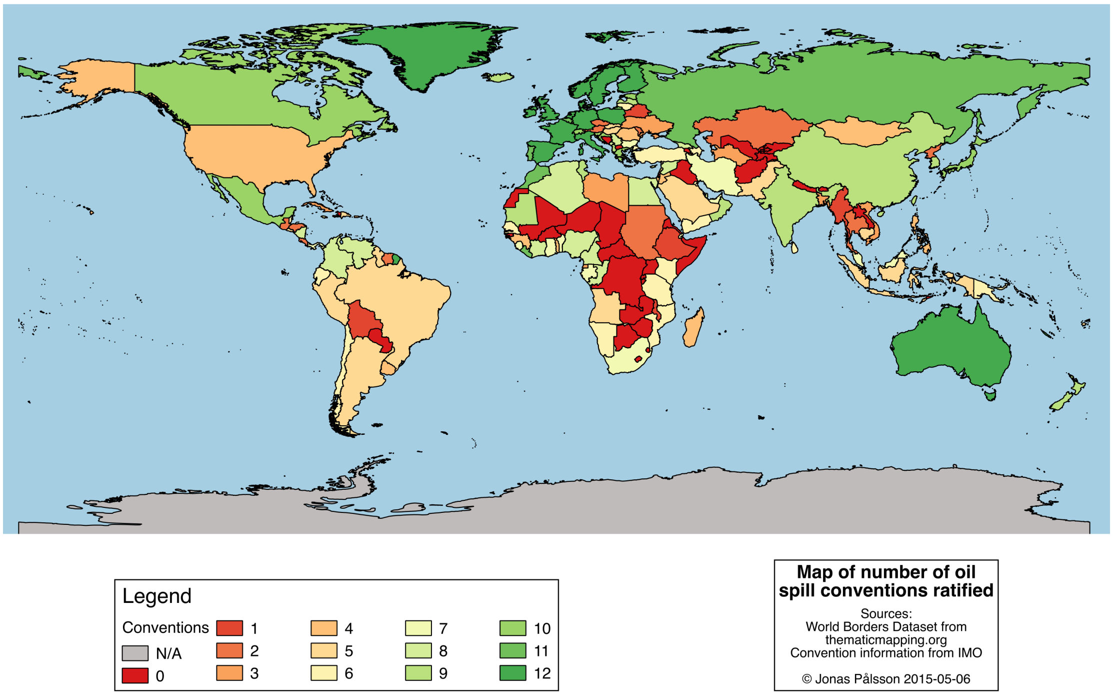

Figure 53: Sum of the ratified IMO Conventions and Protocols on oil spill preparedness (IMO, 2015c).

As seen, Sweden is among the countries with the most oil spill related conventions ratified, scoring 12 of 12 examined conventions.

9.3.2 National Contingency Plans

The countries that have developed a National Contingency Plan (NCP) for oil spill preparedness have been mapped in Figure 54, using information from a variety of sources (AMSA, 2014; Bratfoss, 2012; EEAA, 1998; Essien, Eduok, & Olajire, 2011; Ireland, 2013; ITOPF, 2012a; Japan, 2015; Jolma & Haapasaari, 2014; Ly, 2012; Marinestaben, 2015; MSA, 2000; RAC-REMPEITC, 2015; REMPEC, 2015; Republic of Korea, 2015; Reszko, 2011; Russian Federation, 2003; Skrube, 2010; VPS, 2014).

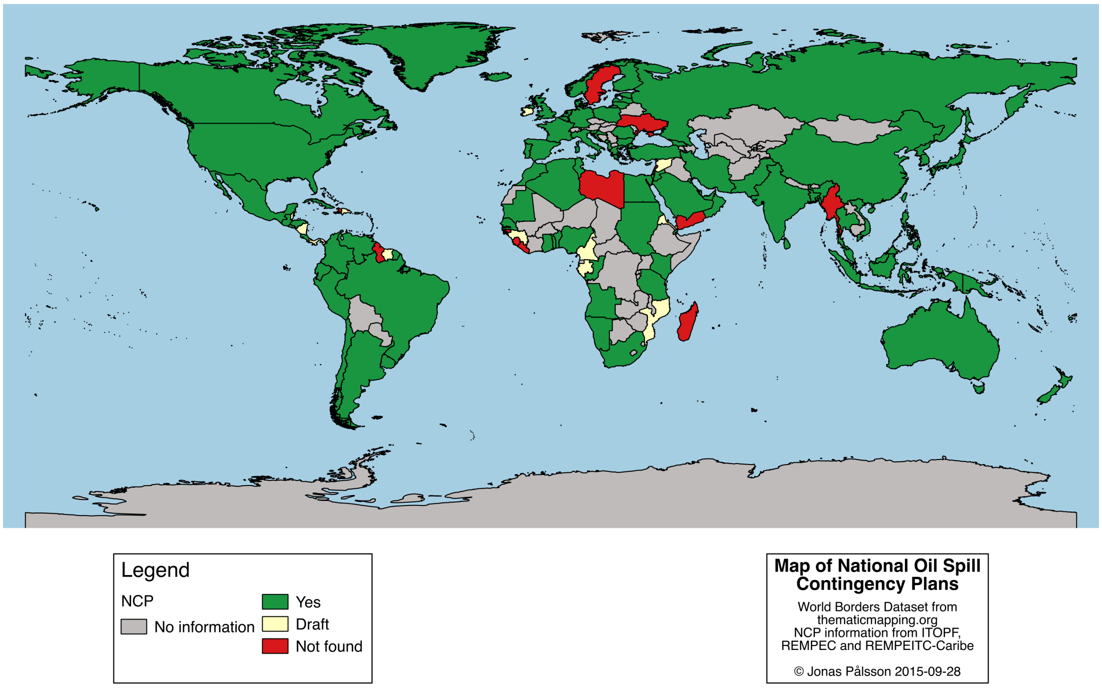

Figure 54: Countries with National Contingency Plans for oil spill response (AMSA, 2014; Bratfoss, 2012; EEAA, 1998; Essien et al., 2011; Ireland, 2013; ITOPF, 2012a; Japan, 2015; Jolma & Haapasaari, 2014; Ly, 2012; Marinestaben, 2015; MSA, 2000; RAC-REMPEITC, 2015; REMPEC, 2015; Republic of Korea, 2015; Reszko, 2011; Russian Federation, 2003; Skrube, 2010; VPS, 2014).

Sweden is one of 15 countries that have been found to not have a National Contingency Plan (10.4%), while 110 have a finished plan (76.4%) and another 19 a draft plan (13.2%) of the 144 countries information was available on.

The correlation between having a NCP and being party to the OPRC Convention was tested statistically (see Figure 55).

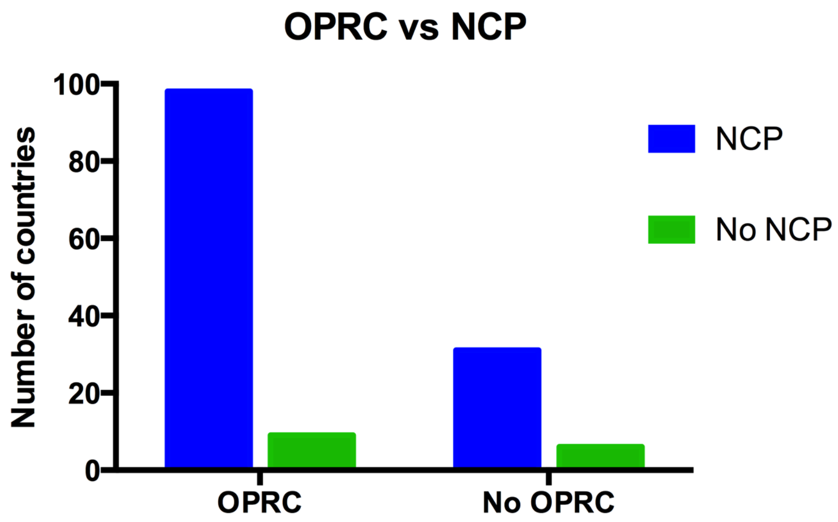

Figure 55: Ratification of the OPRC Convention correlated to the existence of an approved or draft National Contingency Plan.

No difference between ratification of the OPRC Convention and the existence of an approved or draft NCP was found, Berger's test (N = 144), p = .179.

9.3.3 Tiered Preparedness and Response

The use of the Tiered Preparedness and Response concept (IPIECA, 2007) has been mapped in Figure 56, using a variety of data sources (AMSA, 2014; Bratfoss, 2012; EEAA, 1998; Essien et al., 2011; Ireland, 2013; ITOPF, 2012a; Japan, 2015; Jolma & Haapasaari, 2014; Ly, 2012; Marinestaben, 2015; MSA, 2000; RAC-REMPEITC, 2015; REMPEC, 2015; Republic of Korea, 2015; Reszko, 2011; Russian Federation, 2003; Skrube, 2010; VPS, 2014).

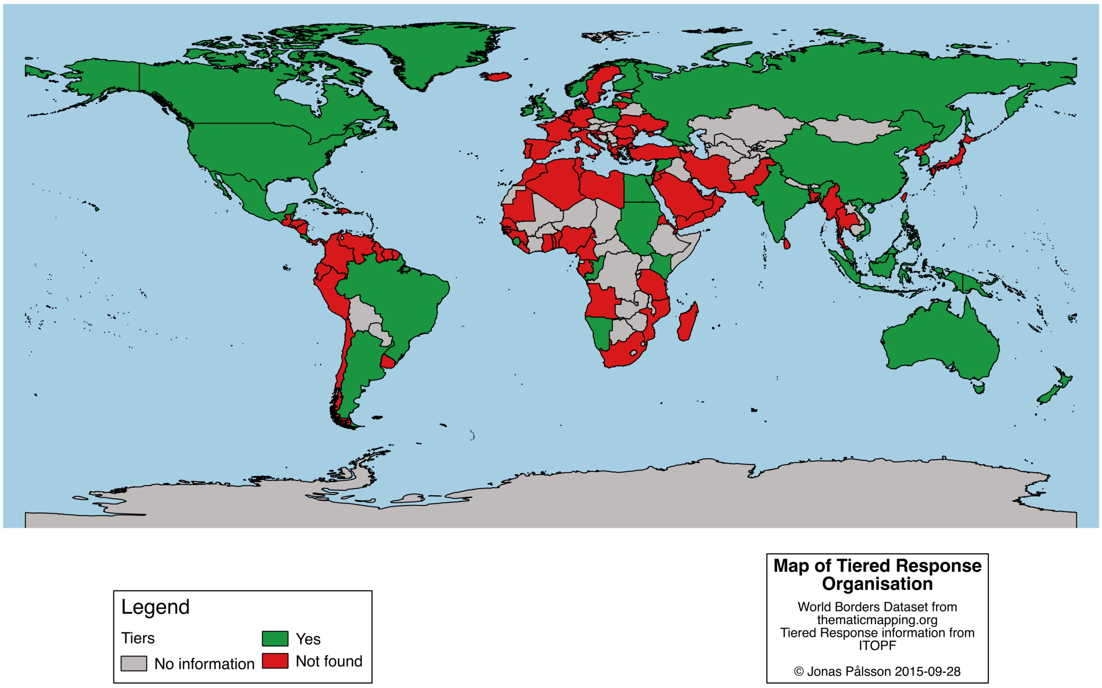

Figure 56: Countries using the Tiered Preparedness and Response concept (AMSA, 2014; Bratfoss, 2012; EEAA, 1998; Essien et al., 2011; Ireland, 2013; ITOPF, 2012a; Japan, 2015; Jolma & Haapasaari, 2014; Ly, 2012; Marinestaben, 2015; MSA, 2000; RAC-REMPEITC, 2015; REMPEC, 2015; Republic of Korea, 2015; Reszko, 2011; Russian Federation, 2003; Skrube, 2010; VPS, 2014).

Sweden is one of 85 countries (59.4%) that have not been found to use the Tiered Preparedness and Response concept, against 58 countries (40.6%) that do of the 143 countries information was available on. However, the Swedish response is nonetheless divided into the municipal responsibility, the SCG responsibility, and the national responsibility in the form of the Oil Spill Depots.

The correlation between having a NCP and using the Tiered Preparedness and Response concept was tested statistically (see Figure 57).

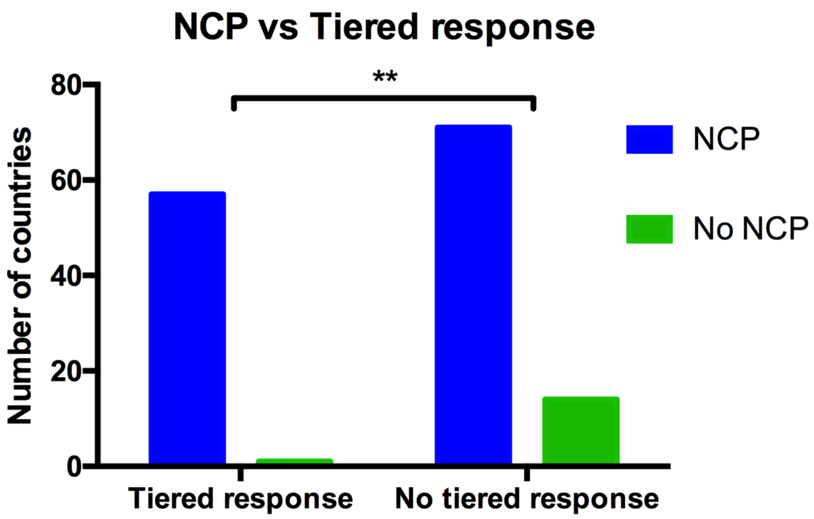

Figure 57: Correlation between having a National Contingency Plan (NCP) and using the Tiered Preparedness and Response concept.

Having a NCP shows a significant effect on using the Tiered Preparedness and Response concept, Berger's test ($N = 143$), $p = .004$.

9.3.4 International targets

Different countries have established target values to their national oil spill response capacity and response tiers or categorisation (see Table 27) (Bratfoss, 2012; HELCOM, 2013a; Jolma & Haapasaari, 2014; Ly, 2012; Marinestaben, 2015; Regeringen, 2014d; Reszko, 2011; Saar, 2010; Skrube, 2010; Transport Canada, 2013; VPS, 2014).

Table 27: National oil spill response capacity targets and categorisation of response tiers in tonnes (Bratfoss, 2012; HELCOM, 2013a; Jolma & Haapasaari, 2014; Ly, 2012; Marinestaben, 2015; Regeringen, 2014d; Reszko, 2011; Saar, 2010; Skrube, 2010; Transport Canada, 2013; VPS, 2014).

Country	National	Tier 1/local	Tier 2/regional	Tier 3/national
Canada		10,000		
Denmark	5,000			
Estonia		<10	<30	>30
Finland	30,000			
Germany		<50	<50	>50
Latvia		<10	>10	
Lithuania	No information			
Norway	No target			
Poland	No target			
Russia		<500	500-5,000	>5,000
Sweden	10,000			

9.3.5 Standardised comparison

The neighbouring countries and the United States were evaluated using the RETOS™ Programme at the National Level A evaluation. The United States represents a country with much developed oil spill preparedness and has been included as a reference. No data could be obtained from Estonia. The total scores of the neighbouring countries ranged from 56% to 98% with an average of 73.1% (see Table 28 and Appendix I - International Practice Results).

Table 28: RETOS™ evaluation scores.

Country	RETOS™ score
Denmark	73
Finland	83
Germany	56
Latvia	66
Lithuania	65
Norway	98
Poland	74
Russia	74
Sweden	69
U.S.	99
Average	73.1
STD	*12.0*

The examined scores of the RETOS™ evaluation were added together to analyse data trends (see Figure 58).

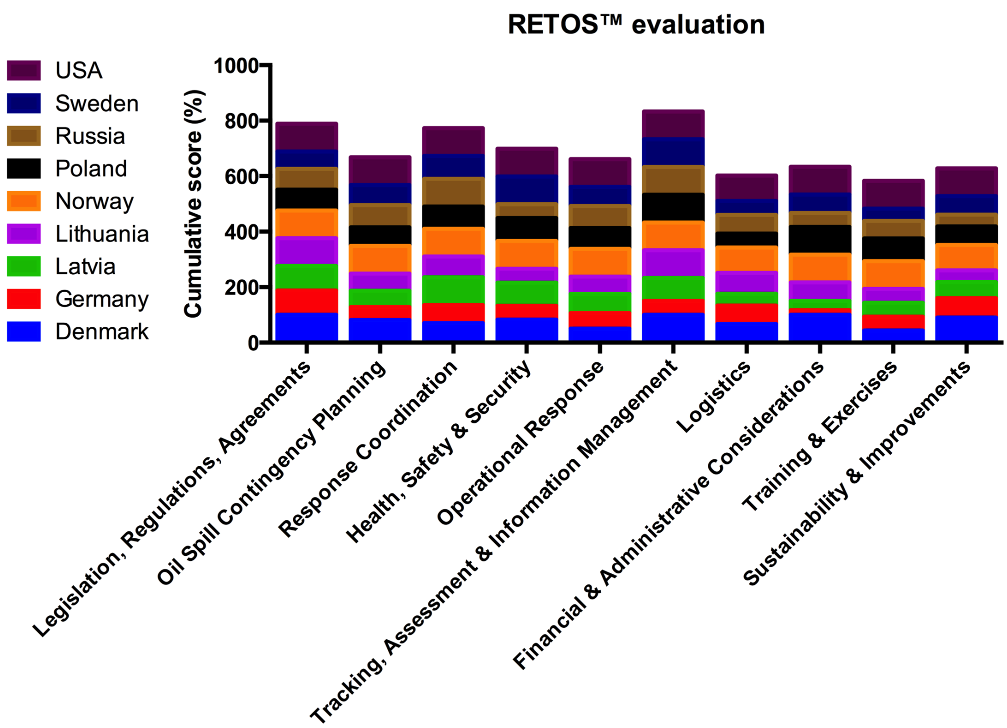

Figure 58: Combined evaluations scores for the Baltic Sea Region countries, including the United States and Norway, but excluding Estonia.

The scores the examined countries are best at are *Legislation, Regulations, Agreements*, *Response Coordination*, and *Tracking, Assessment & Information Management*. The scores of the individual countries were mapped out on a radar chart in Figure 59, and can be observed in detail in Appendix I - International Practice Results.

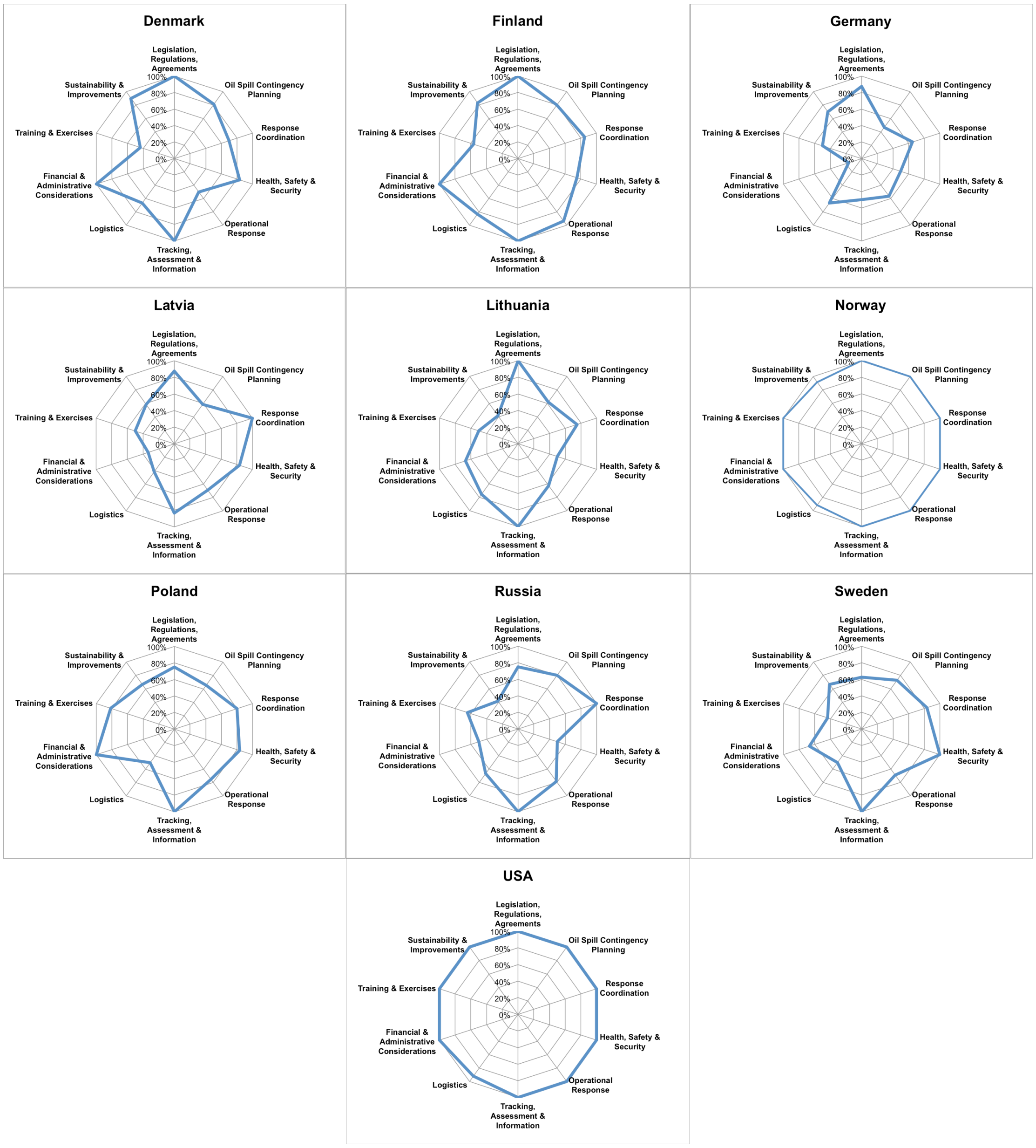

Figure 59: Results of the country evaluations using the RETOS™ programme.

A statistically significant difference was found between the examined countries, Friedman's test (N = 10), $p < .001$. Comparing Sweden to the other countries, Sweden was significantly different from the United States and Norway, Dunn's post test ($N = 7$), $p < .05$.

9.4 Discussion

Setting Swedish oil spill preparedness into a global context helps to both understand the Swedish position in relation to the global oil spill community and explore methods to compare oil spill preparedness between countries.

9.4.1 International commitment

The international political commitment to oil spill preparedness is reflected in the ratification of IMO Conventions related to oil spills. However, the number of ratified agreements varies a great deal between countries (see Figure 53), with Europe and Australia having ratified most of the conventions relating to oil spill preparedness. The landlocked countries with a small or no fleet have ratified few, if any, of these international conventions. To be able to interpret the results correctly, there is a need to understand the global shipping industry. Some countries have adopted national legislation to regulate oil spill risk and impacts from international shipping (for example OPA90 in the United States). This domestic legislation may cover the regulations and requirements of the international conventions, and sometimes surpass them, as is the case of OPA90. Critique and issues relating specifically to the implementation of the international conventions are also abundant, and many countries are accused of only adhering to these conventions on paper (Edwards, 1993; Holt, 1993; Knudsen & Hassler, 2011; Mitroussi, 2004). The main accusation is that IMO aims for the Lowest Common Denominator (LCD), meaning that the ambition is set by the least interested country, in order to get universal acceptance of its conventions through a consensus process (Knudsen & Hassler, 2011; Mitroussi, 2004). In the end, it is the responsibility of the signatory Parties' national governments to sufficiently and correctly implement the international conventions.

Sweden places well in comparison with the international community, by having ratified all of the oil spill conventions and protocols (IMO, 2015c). Much work has been done proactively with international environmental issues and the country can be considered to have implemented the IMO Conventions well, excepting the requirement for a National Contingency Plan and that more resources could be allocated to enforce the implementation, as was discussed in Chapter 6.

9.4.2 Strategic ambition

Similarly to the ratification of the conventions, the international targets for oil spill response vary greatly between countries (see Table 27). It is difficult if not impossible to correctly judge if the response capacity targets are correctly set. However, for the Baltic Sea Region, the Swedish target (10,000 tonnes) is set lower than Finland (30,000 tonnes), despite having a significantly longer coastline, but larger than Denmark (5,000 tonnes), who has a far longer coastline if Greenland is included. For the risk of spills, it is suggested that the elevated risk and distance to shore in the Gulf of Finland may warrant an increased preparedness there (BRISK, 2011; COWI, 2012c; Viertola, 2013). Logically, the target values should be based on comprehensive risk assessments, taking into consideration the traffic situation, the risk of spills, and the coastal sensitivity. It is also noteworthy that these targets are set far below a worst-case scenario.

The Helsinki Commission (HELCOM), the secretariat of the Helsinki Convention (HELCOM, 2008), has outlined a regional target value for the Baltic Sea in the Baltic Sea Action Plan (BSAP) (HELCOM, 2007a).

"Response capacity should be available for responding to a 1,000- 5,000 tonnes (depending on the likely accident in the area) oil spill at sea in favourable weather within 3 days. Local geographical and other specifics (e.g. archipelago area, shallow water, etc.) should be taken into account."

However, this target does not explicitly specify whether the Baltic Sea countries should have this capacity together or per country, but it is implied that this relates to the Baltic Sea sub-regions discussed in the adjacent sections of the BSAP. These sub-regions (see Figure 60) are defined as:

1. Gulf of Bothnia
2. Gulf of Finland
3. Central Baltic Sea
4. Southeast Baltic Sea
5. Southwest Baltic Sea
6. Kattegat and the Belt Straits

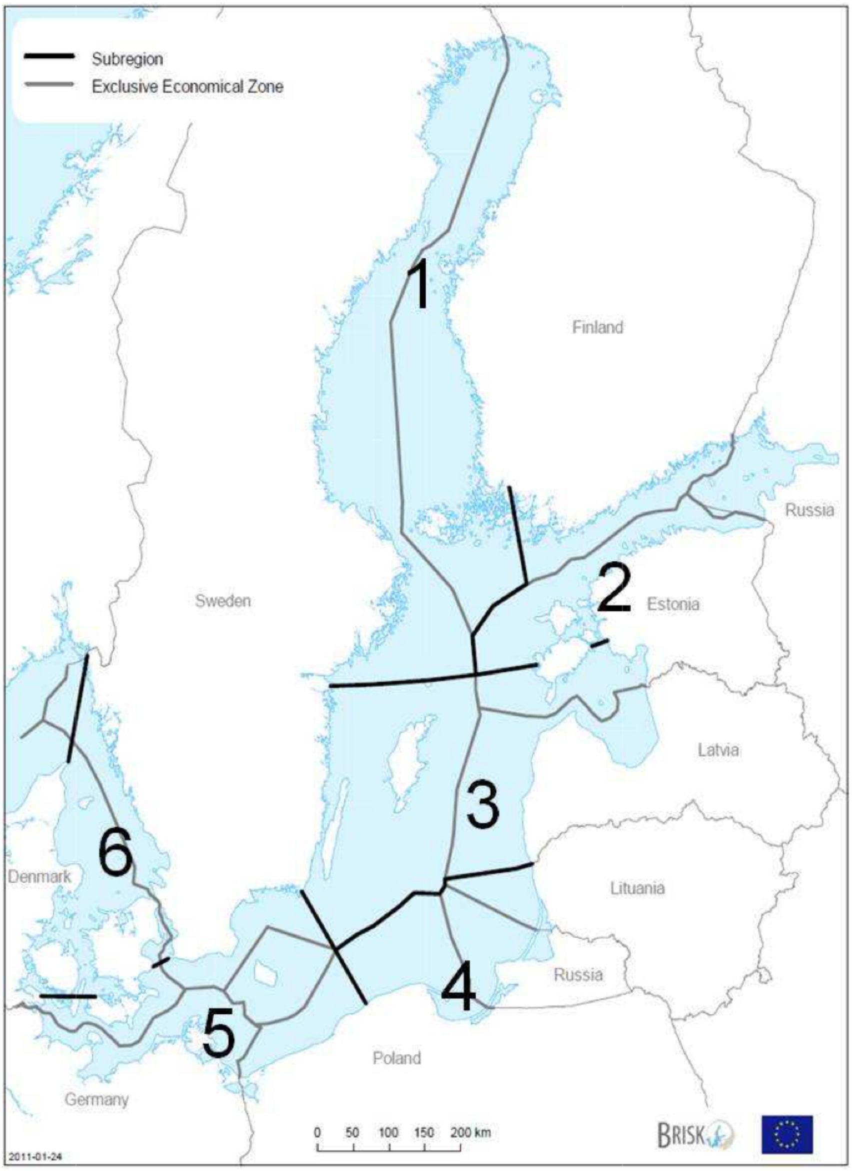

Figure 60: HELCOM and BRISK sub-regions of the Baltic Sea (COWI, 2012b).

The BRISK project developed a detailed Baltic Sea risk assessment and recommended specific response targets for the Baltic Sea based on the BSAP (COWI, 2012b). In these recommendations, the 5,000 tonnes were interpreted to apply to each country in each sub-region (see Figure 60). The BRISK project interpretation was made after consulting the HELCOM experts, as the project worked closely with the secretariat. It is also notable that the target values are not scaled to the length of the coastlines or the size of sea areas of the different countries. Return periods, meaning the estimated time before an oil spill occurs, were also calculated based on the risk assessment for both recommended values and existing values (see Table 29).

Table 29: BRISK sub-regional spill capacity and estimated return period for oil spills (COWI, 2012b).

Sub-region	Sub-region countries	Recommended capacity (tonnes)	Existing capacity (tonnes)	Recommended return period (years)	Existing return period (years)
1	Sweden, Finland	10,000	5,000	800	270
2	Finland, Russia, Estonia	15,000	45,000	380	850
3	Sweden, Estonia, Latvia	15,000	5,000	250	105
4	Latvia, Russia, Poland	15,000	12,000	1,800	1,400
5	Sweden, Denmark, Germany, Poland	20,000	34,000	165	250
6	Denmark, Sweden	10,000	20,000	75	120
Total		**85,000**	**121,000**		

BRISK then consulted the existing response capacity and the planned investments of the Baltic Sea states and found that the overall existing spill capacity is 42.3% higher than the recommendations. However, this conclusion has a few limitations. It assumes that the recommended 5,000 tonnes set in the BSAP is a suitable target value and does not reflect the onshore capacity.

Comparing to the other areas of this risk assessment (see Table 27), the Swedish target of 10,000 tonnes, which has been in place since 2006 (Kustbevakningen, 2007), seems realistic. However, response capacity is extremely dependent on weather conditions. In light of the risk assessments published in recent years (COWI, 2012c; J. Johansson & Molitor, 2011; Rådberg & Gyllenhammar, 2012), a re-evaluation of this goal is needed. As mentioned before, the previous onshore target value of 10,000 tonnes has disappeared from the Swedish Strategy for Oil Spill Preparedness (NSO, 2014b). This frees the response from focusing on an assumed and perhaps unrealistic target value, but also makes it harder to plan for an oil spill that could be interpreted as being 100 tonnes or 100,000 tonnes. Many countries deal with the scale issue through the use of the Tiered Preparedness and Response concept. This calls for a debate in Sweden on whether the response should be planned according to a realistic scenario or a worst-case scenario.

9.4.3 Management system

The results of the development of a country-specific National Contingency Plan (NCP), shows that 110 countries have a NCP and a further 19 have a draft plan of the 144 countries with available information. However, the results need to be interpreted with caution. Three assumptions should be clarified.

- The data do not show the quality of the NCP for any specific country, which likely varies significantly between countries.
- The data do not exclude the existence of a functional contingency planning system with an absence of a NCP, or that regional or local oil spill response plans are in place.
- The data does not reveal if the NCP covers the onshore response or not, as in the Swedish example.

The analysis of the global management systems shows that a NCP is considered a standard practice. There is no correlation between being party to the OPRC Convention and having a NCP (see Figure 54). This reinforces the critique by Knudsen and Hassler (2011) of the limited effect of the IMO Conventions in regulating oil spill preparedness in the individual nations, as the OPRC Conventions was meant to encourage developing countries to increase their oil spill preparedness, in part by establishing NCPs (Holt, 1993). This partially opposes the view of Knapp and Franses (2009), who argued that the IMO Conventions in general have had a positive effect on decreasing pollution from ships.

The usage of the Tiered Preparedness and Response concept shows that 58 countries of the 143 with available information have adopted this concept to varying degrees. However, the boundaries of the different Tiers vary (see Table 27) and it is argued that they indeed should not have specific values (IPIECA, 2007), but be designated by the responsible authority for each spill.

The statistical correlation shows that most countries that have a NCP also adopt the Tiered Preparedness and Response concept (see Figure 57). This is reasonable, as the two measures are strongly associated in the planning community (IPIECA, 2007; ITOPF, 2011b; Jamieson, 2005). As discussed in the introduction, Tiered Preparedness and Response is more widespread in the industry (IPIECA, 2007). This means that most of the response authorities at sea, such as coast guards, navy etc., are familiar with the Tiered Preparedness and Response concept. However, this familiarity likely does not exist among the response authorities onshore. This likely leads to communication issues when collaborating internationally between organisations using the Tiered Preparedness and Response concept and those who do not.

Sweden has a national response system in place, which can and has been interpreted as having a NCP (ITOPF, 2012a). Chapter 6 discussed why Sweden should not be considered to have a NCP, since no such document has ever existed. Having a NCP only covering the response at sea and not on land, may be the case with other reported countries. Thus, a NCP that covers both jurisdictions at sea and on land might be less common than is suggested in Figure 54. The Swedish organisation of not having a NCP, but instead having an established system with separate responsible agencies at sea and on land for the local, regional, and national levels might not be uncommon in practice. But the Swedish case discussed in this dissertation shows that a well functioning system could be in place without the need for the standard practice of having a NCP and using the Tiered Preparedness and Response concept. This suggests that the NCP and Tiered Preparedness and Response concept are not critical and indirectly questions their usefulness.

9.4.4 International readiness

The evaluation results from the RETOS™ Programme show a large variation between the evaluated countries (see Figure 59). It is reasonable that the United States has scored high in all categories of the test, as the RETOS™ Programme, to a large extent, is modelled after the preparedness system in the United States. This model is the most developed system in North and Central America and the United States has great influence in the region. All the basic issues listed in the National RETOS™ Level A evaluation have been addressed in the United States. It is noteable that all of the Baltic Sea countries are more or less developed to the same degree, with an evaluation score between 56% and 74%. Sweden received an evaluation score of 69%, corresponding to the status "*In Development*". Norway and Finland have used part of their oil revenue for developing oil spill preparedness and are expectedly scoring higher than Sweden.

It cannot be ruled out that the better RETOS™ score of the United States compared to Sweden is not because of the Incident Management System (IMS), but because of other factors. Regardless, as discussed in Chapter 5, the IMS may not be appropriate for Sweden in all circumstances. Indeed, Sweden scores high despite the fact that it does not use IMS or the Tiered Preparedness and Response concept, and does not have an NCP.

The evaluation results are not approved as the "official" evaluations by all countries, as not all of the respective governments have cleared them. However, highly qualified individuals, and generally the person responsible for the national contingency planning, supplied the data.

Results from the NSO interviews (January 2015), show a divided opinion among the experts on the statement *"Swedish oil spill preparedness is equivalent to international standard."*. Two informants disagreed with the statement, two were in agreement, and two did not have an opinion (see Figure 61).

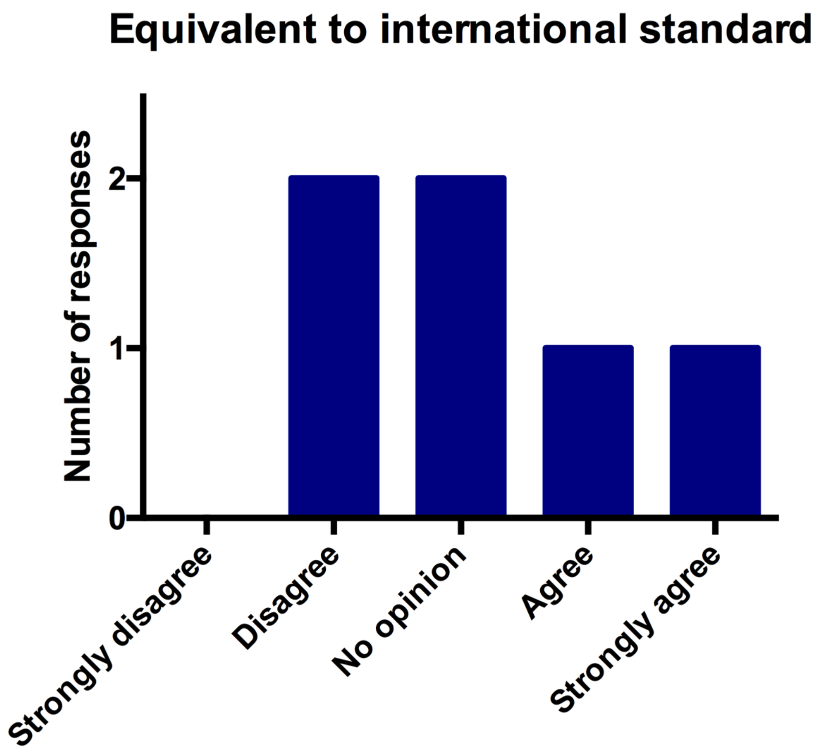

Figure 61: Expert opinion on the statement "*Swedish oil spill preparedness is equivalent to international standard.*".

The informants argue that lessons learned from other countries have been taken into account when developing the Swedish oil spill preparedness. As Sweden is active in several regional agreements and forums on oil spill preparedness, comparable practices to the regional countries have been developed. Informants of both opinions have worked with oil spills or exercises abroad, although primarily in the Baltic and North Sea context. The results of the RETOS™ evaluation shows that the Swedish oil spill preparedness is indeed equivalent to international practice, at least the practice around neighbouring countries.

9.4.5 Implications

It is noteworthy that Sweden scores well using the RETOS™ evaluation, in comparison to the neighbouring countries, despite not having a NCP or using Tiered Preparedness and Response. This suggests that those measures are not be needed to maintain a good preparedness level, although they most likely will help communication during international cooperation and operations.

The scores of the analysed variables for oil spill planning in this chapter have been summarised in Table 30.

Table 30: Scores for the H5 variables.

	Preferable	*Sufficient*	*Insufficient*	Score
Number of conventions	Sweden has ratified a number of conventions more than one standard deviation from the average, equal to more than 87.0%.	Sweden has ratified a number of conventions within +/- one standard deviation from the average, equal to between 16.6% and 87.0%.	Sweden has ratified a number of conventions less than one standard deviation from the average, equal to less than 16.6%.	**100.0%**
Target value	Sweden has oil spill preparedness targets higher than 95% or more of the neighbouring countries.	Sweden has oil spill preparedness targets higher than 50% up to 95% of the neighbouring countries.	Sweden has oil spill preparedness targets lower than 50% of the neighbouring countries.	**50.0 %**
Use of NCP	Sweden follows international practices by having a National Contingency Plan, counted as 100%.	Sweden does not follow international practices, but has a system equivalent to a National Contingency Plan, counted as 50%.	Sweden does not follow international practices by having a National Contingency Plan, counted as 0%.	**50.0 %**
Use of Tiered response	Sweden follows international practices by using Tiered Preparedness and Response, counted as 100%.	Sweden does not follow international practices, but uses a system equivalent to Tiered Preparedness and Response, counted as 50%.	Sweden does not follow international practices by using Tiered Preparedness and Response, counted as 0%.	**50.0 %**
Evaluation scores	Sweden scores more than one standard deviation from the average score of the compared countries, equal to more than 85%.	Sweden scores within +/- one standard deviation from the average score of the compared countries, equal to between 61% and 85%.	Sweden scores less than one standard deviation from the average score of the compared countries, equal to less than 61%.	**69%**

As shown by analysis of the variables in Table 30, none of the variables are ranked *Insufficient*. Since the national ratification of the relevant international oil spill conventions is perfect, the national targets are in line with the neighbouring countries, Sweden is one of few countries that do not have a NCP or use the Tiered

Preparedness and Response concept, but score similarly to the other Baltic Sea Region states, the hypothesis:

H5 – Preparedness in Sweden is equivalent to international practice

is accepted and the null hypothesis $H5_0$ is rejected.

9.4.6 Limitations

The principal dataset for the NCP and the Tiered Preparedness and Response relies on data that is not up to date (ITOPF, 2012a). The oldest record was updated in May 1996, but the majority were updated between 2005 and 2012. Effort has been made to verify this data, but information on the national contingency plans was not publicly available in most countries. Additionally, the interpretation of an NCP and the Tiered Preparedness and Response might vary between countries as well as the actual implementation. Thus, the data should be considered unverified, especially for the developing countries. Primary data sources from the neighbouring countries of Sweden have been used for verification, so these values should be considered reliable. This makes the data from other areas unreliable and a direct comparison should not be made, but are useful as a general indication of the use of NCP and the Tiered Preparedness and Response.

9.5 Conclusion

This chapter introduces a novel method to statistically compare the results of the RETOS™ country evaluations using Friedman's test. However, the method requires some tweaking to make it easier to distinguish between outliers in the material. In this analysis, the United States and Norway are two external controls the Baltic Sea Region countries were compared to for the RETOS™ evaluation. The nature of a rank sum calculation also makes the method more powerful if the number of compared units, the countries, increase. However, most of the RETOS™ evaluation indicators are focusing on the sea response and does not reflect the onshore preparedness and response as well.

The convention ratification, existence of a National Contingency Plan and use of the Tiered Preparedness and Response concept, are considered crude indicators. There are insufficient data available to analyse the National Contingency Plan and Tiered Preparedness and Response concept properly, and a deeper analysis would yield a better result. Thus, the result can only be used as an indication of the global practice of these concepts. However, it is still evident that most countries indeed have a National Contingency Plan, and to some extent use the Tiered Preparedness and Response concept.

However, despite not having a National Contingency Plan or using the Tiered Preparedness and Response concept, Sweden appears to be at a similar oil spill preparedness level to its neighbouring countries. This suggests that a National Contingency Plan and the Tiered Preparedness and Response concept are not critical and indirectly questions their usefulness. This is especially true if other corresponding measures exist, as they do in the Swedish case. The main use for Sweden to develop a National Contingency Plan would be to harmonise the various regional and municipal plans into a national system and use terminology in line with the global practice. This would utilise the best practices from abroad and simplify cooperation and understanding during international operations.

Chapter 10 - Conclusion

The final chapter summarises the dissertation findings and explains the implications to Swedish oil spill preparedness. Recommendations, limitations, and future research topics are also presented.

10.1 Introduction

This dissertation set out to analyse the Swedish oil spill preparedness to manage a large oil spill by analysing its management, and prevention, planning, and response measures. Oil spills refer to oil pollution from ships, pipelines, fixed installations, ports etc. and concerns any oil spills affecting the Swedish territorial sea or EEZ.

Sweden has never experienced any oil spills over 1,200 tonnes and most spills have been below 700 tonnes. This means that responders do not have much real field experience. To majority of the local and regional authorities, the most recent oil spill happened a long time ago, and some areas have never experienced any spill at all. This situation has helped to create a false sense of security, and oil spill preparedness is not generally prioritised in Sweden. Consequently, organisational resources are allocated to other more pressing tasks. However, poor preparedness will presumably lead to a costly response once an oil spill occurs, as the spill will be managed ineffectively and result in an insufficient response (IPIECAOGP, 2015; ITOPF, 2011b; NRT, 1989; Twigg, 2002). Experts agree that a longer time to respond will doubtless result in an increased environmental impact and subsequently an higher cost for clean-up, damage compensation, and environmental restoration, while a well-functioning oil spill preparedness management will lead to a faster and more effective response with significantly less damage and lower cost (Elmgren et al., 1983; Etkin, 2000; Kirby & Law, 2010; Lindén et al., 1979; Smith, 1968; Taylor, Steen, Meza, Couzigou, Hodges, Miranda, Ramos, & Moyano, 2008a; Tegeback & Hasselström, 2012). However, it should be stressed that the amount of oil is not correlated with the amount of damage. Even a small spill can cause significant damage, if occurring for example during bird migration, seal birthing, or fish spawning.

The need for pre-emptive prevention measures, effective contingency planning, and well-trained response measures in order to have sufficient oil spill preparedness in Sweden is put forward in this dissertation.

The aim of this dissertation is to better understand the state of oil spill preparedness in Sweden today and use the findings to recommend improvements. The study sought to answer the overall research question:

> *Is Sweden prepared to handle a large oil spill?*

This question was divided into five sub-questions about Swedish oil spill preparedness:

1. Is the oil spill preparedness regime effectively managed?
2. Is the political commitment for oil spill prevention sufficient?
3. Are the existing contingency planning measures sufficient?
4. Are the existing response measures sufficient?
5. Is the oil spill preparedness regime equivalent to international practice?

10.2 Findings

The main empirical findings on the state of oil spill preparedness in Sweden have been divided into Chapter 5 - Management, Chapter 6 - Prevention, Chapter 7 - Planning, Chapter 8 - Response, and Chapter 9 - International practice, each based on the different research questions.

This section summarises these findings to answer the research questions:

10.2.1 Is the oil spill preparedness regime effectively managed?

In order to be effectively managed, the organisational structure should be logically tied to the organisational responsibilities and the organisations involved should know their place and responsibilities. It was found that:

- The national oil spill preparedness system does not have a hierarchical structure, and only 70% of the organisations have a mandate for oil spill preparedness. This leads to uncertainties regarding division of responsibilities and priorities among the authorities, and potential delays in complex situations where quick decisions are essential for an effective response.
- There is an established network both for contingency planning and for response, covering 83% and 88% of the maximum theoretical connections. The Swedish Coast Guard, the Swedish Civil Contingencies Agency, the Oil Spill Depots, the Swedish Agency for Water and Marine Management, and the Oil Spill Advisory Service are central organisations. However, the Oil Spill Advisory Service contract was discontinued during 2014 and this service faces an uncertain future, which will likely impact the network.
- The respondents generally understand the structure of the management. The role of the Swedish Coast Guard is particularly clear. However, the roles and responsibilities for oil spills of the Swedish Agency for Water and Marine Management and the Environmental Protection Agency are unclear to the respondents. Despite that the Swedish Agency for Water and Marine Management has no direct mandate for oil spill preparedness and its role is viewed as unclear, it occupies a surprisingly central role in the oil spill management network.
- The few connections between the counties, and in some cases between neighbouring municipalities, in the management network suggests a need to implement the Function-based system for larger cross-organisational operations, for example for oil spills.

- In contrast to the situation in most other countries, the oil industry is only peripherally involved in the oil spill planning and response network.

In conclusion, the preparedness regime is effectively managed, as the Swedish oil spill preparedness management structure is generally understood by the involved organisations, it follows a logical division of responsibilities, and has an established network.

10.2.2 Is the political commitment for oil spill prevention sufficient?

In order to have sufficient political commitment, the relevant international conventions should be ratified and international agreements should be signed and have been implemented and budgeted for. It was found that:

- Sweden follows its political commitment for safety and environmental protection by having all international conventions related to oil spill preparedness ratified and all international agreements signed, as well as taking an active part in implementation and enforcement.
- Sweden does not fulfil the requirements of the OPRC Convention, by not having a National Contingency Plan. The Swedish Coast Guard Emergency Response Plan appears to have been interpreted internationally to be the National Contingency Plan, but neither this nor the document developed by the Swedish Civil Contingencies Agency fulfils the criteria defined in the OPRC Convention. However, the Swedish preparedness system is functional despite not having a National Contingency Plan, and such a plan is therefore not necessary, unless it regulates other issues, for example training and exercises.
- The funding for preparedness measures and agencies has increased by 24% between 2010 and 2015 and seem sufficient to accomplish the mandates. However, there is still a need to redistribute the organisations' internal budgets to prioritise oil spill preparedness.

In conclusion, the political commitment is sufficient, as all international conventions related to oil spill preparedness are ratified and all relevant international agreements are signed and implemented (with the exception of having a National Contingency Plan), and as sufficient budget to maintain oil spill preparedness for the relevant government agencies and municipalities has been found.

10.2.3 Are the existing contingency planning measures sufficient?

In order to have sufficient oil spill contingency planning measures and since Sweden does not have a National Contingency Plan, the planning responsibility lies with the municipalities. The municipalities supported by the County Administrative Boards should have updated oil spill contingency plans, taking into account risk assessment and sensitive areas. It was found that:

- Only 27% of the municipalities and 33% of the County Administrative Boards have a risk assessment for oil spills.
- Sensitivity mapping tools are used by 78% of the coastal municipalities, but most of the data are based on digitised maps from the 1960s.
- Although there has been an increase in the development of plans between 2011 and 2015, only 79% of the coastal municipalities have an oil spill contingency plan.
- In contrast to the governmental agencies, the resources for oil spill planning among the municipalities appear to be sufficient for the current level of activity as there is no difference in contingency planning and exercise activity between municipalities with increased or decreased resources for oil spill preparedness during the last five years. This suggests that other factors than resources determine the oil spill preparedness development within the municipalities.

In conclusion, contingency planning measures are not sufficient, as only a few of the municipalities and County Administrative Boards have performed risk assessments, have an updated oil spill contingency plan, or use environmental sensitivity maps.

10.2.4 Are the existing response measures sufficient?

In order to have sufficient response measures, all municipalities would have to be properly trained and frequently conduct oil spill exercises. Available equipment should be located close to the risk areas in sufficient quantities. A systematic training, exercise, and evaluation regime and engagement in external projects should be evident. It was found that:

- The level of formal oil spill training among the coastal municipalities is only 70% for the basic course on *Environmental impacts* and up to 23% for the advanced course as a *Staff specialist*. Given the recent move from a no cost to a fee-based system for training courses, participation in the courses will likely decrease.
- Regional equipment centres exists in the Oil Spill Depots and equipment have not been reported to be a limitation during any of the recent real oil spill responses.
- Only 60% of the municipalities have exercised their contingency plans within the last 5 years and many have never exercised their plans at all. Requirements for regular tabletop and deployment exercises should be enforced by the authorities, in order for the training to have a lasting effect on the organisations and in order to build needed inter-organisational relationships.
- Results show that exercises are closely associated with the EU oil spill projects examined, suggesting that a main driving factor is involvement in external oil spill projects.
- The recent nine exercises and two real oil spill evaluations that have been analysed showed that only 45% use an established evaluation methodology,

and although 73% give recommendations, only 18% of them required any follow-up.

In conclusion, response measures are not sufficient, as municipal training is low, not all Swedish municipalities have conducted an oil spill exercise, no common evaluation method for exercise is used, recommendations are not followed up, and conducted exercises are to a great extent driven by external projects.

10.2.5 Is the oil spill preparedness regime equivalent to international practice?

In order to have a level of oil spill preparedness equivalent to international practice, the relevant international conventions should be ratified, a National Contingency Plan and Tiered Preparedness and Response concept should be used, and the oil spill preparedness target value and RETOS™ evaluation score should be in line with those of the neighbouring countries. It was found that:

- Sweden is one of the countries that have ratified all of the relevant oil spill preparedness conventions, although the implementation of the OPRC Convention 1b § 6 is lacking.
- The Swedish oil spill response capacity target of 10,000 tonnes at sea is similar to those of the Baltic Sea Region countries. However, this number should be reviewed in light of the changed oil spill risk in the Baltic Sea.
- Despite not using the common international practices of having a National Contingency Plan or using the Tiered Preparedness and Response concept, Sweden has a RETOS™ evaluation score close to the Baltic Sea Region countries, but significantly lower than the United States and Norway.

In conclusion, Sweden has an oil spill preparedness level equivalent to international practice, as ratification of the relevant international oil spill conventions is perfect, systems similar to a National Contingency Plan and Tiered Preparedness and

Response concept are used, and national oil spill preparedness targets and RETOS™ evaluation scores are comparable to those of neighbouring countries.

10.2.6 Conclusion

Considering the variables ranked *Insufficient* among the results, the main hypothesis

Hmain – Sweden is prepared for an oil spill of 10,000 tonnes

is rejected. Following the rationale in Chapter 4, all of the embedded hypotheses must be ranked *sufficient* for the main hypothesis to also be ranked *sufficient*. If any of the variables are *insufficient*, important links in the Swedish oil spill preparedness is missing.

But a rejection of the main hypothesis does not mean that Sweden is unprepared for a large oil spill in all aspects. This dissertation has shown that the country is on the whole well prepared. However, Sweden is shown to be insufficient in some important aspects of preparedness, for example management, training, and exercises, which leads to the rejection of the main hypothesis.

It is concluded that the current level of preparedness is not structured to handle an oil spill as large as 10,000 tonnes. An oil spill of that magnitude would likely take several years to clean up. However, each spill is unique and favourable conditions (e.g. calm weather, proximity to infrastructure, and qualified personnel) for a large spill could mean that it could be handled, while unfavourable conditions (e.g. stormy weather, remote locations, and limited qualified personnel accessible) for a small spill, could mean that it cannot be handled (Etkin, 2000; IPIECA, 1994a; ITOPF, 2011b; Singsaas & Lewis, 2011).

10.3 Implications

This dissertation has increased the knowledge concerning oil spill preparedness in Sweden by analysing the relationships in the oil spill preparedness management network, and measures affecting oil spill prevention, planning, and response. The understanding of the Swedish oil spill preparedness has enabled comparative analyses to neighbouring countries and international practices. The theoretical implications of this study are discussed below.

10.3.1 Management theory

The non-hierarchical team-based structure of the Swedish management of oil spill preparedness has been described in detail in Chapter 5. The theoretical advantages of a Function-based structure (Buck et al., 2006; IPIECAOGP, 2014a; Lindell et al., 2005) over a traditional Team-based organisational (ITOPF, 2012b) structure has also been discussed, using the Swedish example.

This dissertation shows that it is possible to build a working oil spill response management system without a Function-based structure, as has been done in Sweden. This supports Waugh and Streib's (Waugh & Streib, 2006) arguments that centralisation is unrelated to response effectiveness. However, it is suggested that the Swedish Team-based structure will work up to a certain scale, above which this structure will lose effectiveness. This concerns complex operations and has been suggested after the large forest fire in Sweden during 2014 (Sjökvist, 2015). This critique specifically targeted the lack of responsible parties at a national level and the prioritisation between different counties.

Although the RETOS™ evaluation gives the Function-based countries like the United States and Norway higher scores than Sweden, it is difficult to interpret the effect of the management structure using the evaluation scores. This study does not go as far as Waugh and Streib who suggest that centralisation is destructive for preparedness. Waugh and Streib (2006) argue that authority by itself, without trusting relationships already established between the involved actors, offers an inadequate basis for coordination. Compared to the United States, Sweden is a much smaller country, which makes it easier to develop and maintain the personal connections emphasised separately by Ödlund (2010), Moynihan (2009), and Buck (Buck et al., 2006).

However, if the organisations are not coordinated and are too autonomous, there will be a lack of centralised direction and the possibility of parallel work (Moynihan, 2009), exemplified by the Tjörn oil spill (MSBHaV, 2014). This suggests that a size span exists, where the Team-based structure works best in smaller countries with a limited number of organisation and personnel in an operation (like the Swedish case), and the Function-based structure works best in larger countries with several organisation and a multitude of personnel (such as the state-wide disasters in the United States). Considering the low number of connections between the counties in Sweden, and between some of the neighbouring municipalities, it can be argued that there is indeed a need for the Function-based system. If such a system would be universally used in Sweden among the responding agencies, it would be easier for the agencies to find their place. Time may otherwise be lost when agencies and organisations unfamiliar to each other have to start to cooperate during a stressful response.

The uncertainty regarding the roles of the Swedish Agency for Water and Marine Management and the Environmental Protection Agency implies that there is little knowledge about the mandates of these organisations. The results of this dissertation generally reinforces Moynihan (2009), in that untrusted organisations are only peripherally included in the management structure, and may require more effort to find their place and make a positive impact. However, the central role of the Swedish Agency for Water and Marine Management revealed in this study does not agree with Moynihan's research, implying that other factors likely play an important part here. Speculatively, this could be linked to the expected functions of an unknown agency, even when no prior trust has been established, as explained by Meyerson et al.'s (1996) concept of *"swift trust"*. Swift trust is the process where members in temporary groups relate to each other according to their roles rather than as persons.

Consequently, swift trust is built on professionalism and not on character and could be especially influential when strangers cooperate.
Quarantelli's (1982) principle:

"Planning should be based on what is likely to happen. While catastrophic and worst-case disasters do occur, preparedness efforts should focus first on disaster scenarios that are typical and probable. Plans should be based on empirically grounded assumptions about how members of the public will respond in emergency situations, rather than on "common sense" ideas or myths about disaster behavior. There is considerable continuity between how people behave during non-disaster times and how they behave in disasters. Rather than developing plans that require people to do things differently, planners should take this continuity into account."

is not applicable to an oil spill context. The Baltic Sea risk assessment (COWI, 2012c) showed that *"no oil spill"* is the most likely event. On the contrary, oil spill preparedness should be planned around a worst-case, or at least a "realistic" worst-case scenario. This is the philosophy used in the United States National Preparedness For Response Exercise Program system, when choosing exercise scenarios (Reiter et al., 2005). However, as was noted in Chapter 3, Quarantelli's principles are primarily based on research on natural disasters, and need some interpretation for application on oil spill disasters.

10.3.2 Network theory

The network graphing is a novel way to visualise the organisations involved in oil spill planning and response, and has never been used before in the Swedish context. Kupucu (2005) used this approach to map out the connections and organisational influence when analysing the 9/11 World Trade Centre response, although this was based on the degree centrality and closeness. The analysis in this dissertation instead used the eigenvector centrality measure, which contains more information as it includes the influence of each node's neighbours (Newman, 2008).

The Swedish network structure shows a few nodes with a high number of connections and a majority of nodes with few connections. This shows that the Swedish oil spill preparedness network is similar to the common pattern described by Newman (2003).

10.3.3 Evaluation theory

The RETOS™ Programme evaluation is another novel way to evaluate the preparedness in the Baltic Sea Region. It has been used before in the Caribbean, but there are few evaluations publically available (Taylor et al., 2014). Thus, this study includes some of the first tests with this model outside of Central America and the Caribbean. This dissertation has shown that it is possible to apply the model successfully to the Baltic Sea Region. However, there are issues with some of the questions, as they refer specifically to details that concern the Incident Command System primarily used in the United States.

The findings suggest that the structure of the RETOS™ Programme may not be as meaningful to apply in an international context not using a National Contingency Plan and Tiered Preparedness and Response, and further refinement may well be needed in order to make the programme less focused on the system of the United States.

10.3.4 Policy implication

The particular policy programme this dissertation is meant to impact is the Swedish oil spill preparedness policy, which is currently being updated by the National Cooperation Group for Oil Combating (NSO, 2014a). Furthermore, the Swedish Strategy for Oil Spill Preparedness (NSO, 2014b) has recently been revised from the previous strategy (Kulander et al., 2004), and harmonised with the new governance structure and responsibilities that the creation of SwAM produced. This strategy is being followed up with a draft national Action Plan that has been sent for review during 2015 to all the affected organisations, and additionally followed up by multiple regional hearings during mid-2015 (NSO, 2015).

This dissertation argues that there is a need to maintain the momentum that has been built around several EU projects on oil spill preparedness during the last five years. This study has used empirical evidence to show that the Oil Spill Depots and the Oil Spill Advisory Service (OSAS) have been an essential part of the oil spill preparedness, and that complete removal of these services will severely impact the Swedish oil spill preparedness regime. The new locations and resource pool for staff for the Oil Spill Depots have not been tested yet, and it is too early to evaluate this new arrangement. As some Depots have been moved closer to risk areas and some further away, the net effect is difficult to analyse.

It has been shown that the use of a National Contingency Plan for oil spills and the Tiered Preparedness and Response concept is not required for an adequate level of preparedness, as Sweden has evaluation scores similar to neighbouring countries that have these measures. However, the widespread use of National Contingency Plans and the Tiered Preparedness and Response concept abroad and especially in the oil industry is a good argument for familiarising responders with the terminology, especially for international operations.

10.4 Recommendations

The research findings clearly argue for several measures that should be undertaken by Sweden in order to secure a sustainable and somewhat increased oil spill preparedness. The six most important measures are presented below in order of importance.

10.4.1 Establishment of a national oil spill fund

Sweden should establish a national oil spill fund, in line with the systems in the United States or Finland. These funds were established to serve as a national system for damage compensation and response costs, covering cases where no polluter can be identified or where costs cannot be recovered, and also for research and development (NPFC, 2006; Syke, 2014; USCG, 2013). The United States Oil Spill Liability Trust Fund is based on a tax of 8 cents per barrel (raised from 5 cents in

2009, ~67 cents per tonne) of oil imported and has accumulated around 1 billion USD. The Finnish fund collects 2–3 million EUR in annual revenue from an oil pollution protection fee on oil imported to, or transported via, Finland (Syke, 2014). If Sweden would establish a similar fund, the corresponding revenue could be used to support risk assessments, sensitivity mapping, training, exercises, equipment, research, and monitoring. Primarily, it should be used as a buffer to compensate the municipalities in situations where the IOPC Fund cannot be used, similar to the Finnish model. This would serve the polluter-pays principle and could help Sweden maintain a higher level of preparedness. Such a fund was suggested already in 1979 (Norrby et al., 1979). However, this fund was never established, but would have been useful to cover extra costs, for example during the Tjörn oil spill, as the clean-up ended partially because there was no more money from the insurance company. Additionally, the municipality had to take expensive loans during the clean-up phase, while waiting for reimbursement from the insurance company. This situation could have been mitigated if a national oil spill fund had existed. Finally, such a fund could be used to send appropriate staff abroad as participants or observers during international oil spills or exercises.

10.4.2 Introduction of mandatory exercises

A mandatory exercise system should be established in regulations, to require the County Administrative Boards and municipalities to exercise their disaster contingency plans frequently. In these exercises, oil spills should be a recurring theme. The frequency of the oil spill exercises should follow the suggestions in Chapter 5, which suggests holding international tabletop exercises once every 4 to 5 years and national, county, and municipal tabletop exercises once every 2 to 3 years. Further suggestions include conducting international, national, and county deployment exercises once every 4 to 5 years and municipal deployment exercises every 2 to 3 years. These could potentially be the same exercise, which is added to a topic at a time, as suggested by Reiter (2005). These exercises should be externally evaluated, in order to systematically measure preparedness development, and be properly followed-up by the organisations themselves. A step in this direction has been taken in the draft action plan of the Swedish Strategy for Oil Spill Preparedness, which designates the County Administrative Boards to coordinate exercise needs in their respective county (NSO, 2015).

10.4.3 Establishment of a national task force

There is an obvious need for a qualified unit that can provide expert advice for planning and on-site guidance during real oil spills. This function has previously been performed by the Oil Spill Advisory Service under contract with the Swedish Agency for Marine and Water Management. Funding to maintain the Oil Spill Advisory Service has not been found, and no agency is willing to take responsibility, even if all agencies acknowledge the importance of this service (NSO, 2015).

As an alternative to the Oil Spill Advisory Service, a national task force of oil spill experts from different agencies could be formed on demand. The Swedish Civil Contingencies Agency already has such a system in place for disaster response with a pool of qualified personnel that can be deployed on short notice when needed. The rescue service staff that previously manned the Oil Spill Depots until April 2015 was included in this staff pool when the Depots themselves were physically moved to the Swedish Coast Guard stations. This staff pool could be expanded to include expertise on management, environmental impacts, and oiled wildlife response, creating a national task force for all oil spill issues that can be called upon when needed. However, such a task force opposes the reasoning that trust is an important factor for a successful response (Buck et al., 2006; Ödlund, 2010; Waugh & Streib, 2006). This is because a specialised unit for rare events will have few, if any, personal connections to the local municipalities. Consequently, a task force would likely work best if it was integrated into regular exercises or permanently attached to an organisation, as the Oil Spill Depots or the Oil Spill Advisory Service were previously organised.

10.4.4 Involvement of research institutes

It is interesting to note that hardly any research has been done on the latest larger oil spills in Sweden. For example, the Söderhamn spill of pine oil was the first spill of its kind and the oil behaved differently than the producers had predicted. In addition, regular marine monitoring programmes have not been used to assess oil spill pollution effects in the affected areas. This is related to the very limited scope of funding available for such studies, with multi-year studies requiring time to prepare and process. However, a recent disaster management review called for further research in Sweden on the effects and management of large and complex response operations (Danielsson et al., 2012).

There are few research groups on oil spill effects and management in Sweden outside of the Maritime Environmental Research Group at the World Maritime University, notably the Department of Shipping and Marine Technology at Chalmers University, the Environmental Studies Research Group at Södertörn University College, and the Maritime Science Research Group at the Kalmar Maritime University. There are also research groups focused on natural disaster management, for example the Risk and Crisis Research Centre at the Mid Sweden University, the Centre for Natural Disaster Science, and the Swedish Defence University. These research institutes would benefit from being more involved in oil spill and response management and could help to evaluate and shape it according to the research findings.

10.4.5 Establishment of a management system for national disasters

Evidence suggests that due to limited connections between the counties, and sometimes between neighbouring municipalities, communication and cooperation between them will be hampered by differences in organisational training, design, procedures, and titles (Lindell et al., 2005). The degrees to which municipalities and County Administrative Boards cooperate with agencies on oil spill preparedness also vary. Consequently, there is a need for a different management structure when cooperating on large and complex operations on a national level, such as responding to large oil spills. This dissertation suggests a system similar to the Incident Command System used in the United States (Lindell et al., 2005), or the state response organisation used in Norway (Kystverket, 2015). In the current Swedish planar structure, all agencies are at the same hierarchical level. Discussing and agreeing response actions taken and how to priorities may delay urgent decisions, especially as it involves multiple agencies, County Administrative Boards, and municipalities with potentially conflicting interests and priorities. The Incident Management System has two important advantages: 1) a hierarchical structure would be helpful to assign a responsible organisation or individual (with the intention that unresolved issues will not ignored, not to assign any blame), and 2) the different organisations would be familiar with the organisational structure, tasks, and mandates. However, such an Incident Management System would still require training and frequent exercises to familiarise the involved organisations with their roles, as the inter-organisational relationships are more important for building trust. Additionally, an Incident Management System could be used to engage different volunteer organisations and formally assign them a place in the preparedness system.

Although evidence suggests that a National Contingency Plan is not needed for the Swedish oil spill preparedness to function, an Incident Management System for use during national emergencies could be developed through a National Contingency Plan. This plan could also be used to clarify the issues with the division of responsibilities, and regulate training and exercise requirements and preparedness levels.

10.5 Limitations

This study has assessed the effectiveness of the important national development of Swedish oil spill preparedness. The research was conducted between 2009 and 2015 and is based on publicly available data, interviews with experts from the national oil spill authorities, and surveys administered to the coastal County Administrative Boards and municipalities. As a direct consequence of this methodology, the study has a number of limitations that have been considered during its formation and discussed in the methodology chapter. Additional minor limitations have been encountered during the course of the study.

The major additional limitation is time and access. There was insufficient time and language access to go into detail regarding the countries that were compared to Sweden. An optimal approach would be to select all the Baltic Sea Region countries and perform a more elaborated in-depth analysis on each one, in order to compare the countries. Such a meta-analysis would identify crosscutting issues and give input to the work of the Helsinki Commission response and onshore working groups. Another approach would be examining oil spill preparedness in other regions, such as the Atlantic, Mediterranean, or Southeast Asia regions.

10.6 Future research

The scale of the oil spill preparedness discussion is extensive and many issues are inconclusive. Several questions suitable for further research have been discovered during the course of this study. Exploring them will provide greater insights into the topic and increase the level of national and local preparedness.

10.6.1 Alternative fuels

In striving towards lower emissions and becoming more environmentally friendly, many alternative fuels have been developed in recent years, for example different kinds of biofuels. These fuels have generally not been spilled, but their behaviour if spilled may not be as expected. For example, the pine oil spill in Söderhamn 2011 is an example of an alternative oil (although not used as fuel) that did not behave according to expectations (Holmström et al., 2014). There is a need to review and test existing response measures for such alternative fuels.

10.6.2 Communication strategies between national and local authorities

Communication between national and local authorities in Sweden needs to be improved during an emergency response. With several different agencies involved, the national authorities need to maintain good communication without getting the message confused. An analysis on the adequacy of existing communication channels and their use is needed, as well as an analysis of how social media impacts this communication.

10.6.3 Environmental sensitivity mapping

Environmental sensitivity mapping is currently not harmonised on any level in Sweden. There is a need to develop Swedish criteria for prioritisation of marine areas that are sensitive or important for oil spills. These prioritisations need to be practical enough to be useful during oil spill response, while still being simple to understand. An analysis of different sector uses and how they should be weighed in comparison to each other is needed and would additionally be relevant to Marine Spatial Planning. It would also be interesting to analyse how calculations of ecosystem services can contribute to mapping and prioritisation.

10.6.4 Evaluation models

There is a need to test the RETOS™ programme evaluation model against another evaluation processes to study its strengths and weaknesses. As has been shown in this dissertation, it does not work as well when evaluating countries that do not use an Incident Command System. Comparative analyses to other frameworks are needed to validate RETOS™ and other evaluation models. Additionally, statistical models for comparison are needed to analyse the results of the evaluation.

10.6.5 Improved transition

One of the identified bottlenecks in Sweden concerns the transition from the emergency phase to the clean-up phase of an oil spill response. An analysis of the definitions of the transition and the transition process itself is needed. Additionally the end phase of the clean-up is in need of analysis, as this decision is also subjective. In the Tjörn oil spill, clean-up was essentially stopped when there was no money left to spend, which may not be the preferred end point (MSBHaV, 2014).

10.6.6 Initiative among municipalities

There is an organisational interest to study what processes and mechanisms are required to engage municipalities in rare events such as oil spills. This dissertation has shown that some municipalities have maintained the momentum after participating in external oil spill projects (for example by implementing a schedule of contingency plan exercises and revisions), while others have not. It also showed that funding is not an issue, suggesting that important driving forces may instead be dedicated individuals, policies, or specific events. An analysis of processes and mechanisms that helps the municipalities to implement and maintain project results is needed to improve governance.

10.6.7 Management structure change

This dissertation has shown that there is a need for a management structure designed for large national disasters. An analysis of how such a management structure should be organised and when it would be relevant to use is needed. Furthermore, a comparison between the bottom-up approach, by structuring the response according to the needs of the local responders, the top-down approach, where the national legislation is changed and the local responders are trained accordingly, or a mix of these approaches, is needed. Clarifications on the use of such a system for different types of disasters would also be necessary, for example for oil spills, forest fires, refugee crises, tsunami evacuations, and floods.

10.6.8 Monitoring

Only levels of PAHs in blue mussels and sediment concentrations are currently applied for environmental monitoring after oil spills in Sweden, primarily based on historic oil spills. An analysis of whether these existing indicators are still valid today, or if other measurements and indicators have been developed is desired. A comparative analysis of the use of these indicators on the Swedish west coast and in the Baltic Sea is also vital, as these environments are quite different and blue mussels do not exist in most of the Baltic Sea.

10.7 Concluding remarks

It has been 12 years since *Fu Shan Hai* sparked the most recent wave of development for Swedish oil spill preparedness in 2003. This period has likely seen the most influential development of oil spill preparedness since that which followed the *Tsesis* oil spill in 1977. Oil spill preparedness and response management have been tremendously improved. The last of the relevant international conventions have now been signed, most of the coastal municipalities have developed or updated their oil spill contingency plans, and several response exercises including onshore activities have been carried out. However, this momentum needs to be maintained and not abate. After increased attention and activities following oil spills, such as *Fu Shan Hai*, diverted priorities will weaken national oil spill preparedness as time goes by. After all, oil spills are rare occurrences and follow the saying *"Out of sight, out of mind"*.

The draft action plan that is being circulated for comments during 2015 reveals new developments for the Swedish Strategy for Oil Spill Preparedness. The plan does not have any proper actions listed, but rather lists priorities and assigns responsible organisations to develop these. Most importantly, the responsibility for oil spill contingency planning, training, and exercises are firmly lifted to the regional level, giving the County Administrative Boards more responsibilities for oil spill preparedness. This is a welcomed development, as a regional approach to planning is more realistic considering the few oil spill accidents that occur. However, there is a danger that municipalities will assume that all responsibilities for oil spill preparedness now belong to the County Administrative Boards. Careful communication and balancing is needed to disseminate the proper responsibilities.

There are still no agencies willing to accept responsibilities and costs for the oil spill support resources: the Oil Spill Advisory Service, the Digital Environmental Atlas, and the oil spill drift model SeaTrack Web, despite being declared to be of national importance in the Swedish Strategy for Oil Spill Preparedness. The lack of responsibility for these resources is unfortunate and has a negative effect on the national oil spill preparedness, as these support resources struggle in limbo without development and with an uncertain future. The draft action plan acknowledges the lack of training and exercises and assigns the National Cooperation Group for Oil Combating to develop a national training and exercise strategy, which is in line with the results of this dissertation. An essential issue not covered in the draft action plan is funding. This dissertation strongly suggests that an oil spill fund should be developed in Sweden, already suggested in the wake of the *Tsesis* accident 35 years ago. Such a fund would greatly help to improve Swedish oil spill preparedness, by funding maintenance and development the oil spill support resources, as well as training and exercises for municipalities, County Administrative Boards, and other relevant organisations.

This dissertation establishes the strengths and weaknesses in the Swedish oil spill preparedness regime in 2015 and calls for further development. The benefits of maintaining and improving the current level of preparedness far outweigh the effort, but will only be evident when a large oil spill occurs.

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Appendix A - Questionnaire

Questionnaire distributed to all 126 municipalities and 18 County Administrative Boards with a coast to the ocean or the three largest Swedish lakes, Vänern, Vättern, and Mälaren during winter 2014.

Oil spill preparedness in Sweden

Introduction

Page exit logic: Agreement**IF:** Question "Do you agree these terms and would like to participate in this survey?" #1 is one of the following answers ("No") **THEN:** Disqualify and display: "Thank you for your time."

3/12-2014

Dear Participant,

My name is Jonas Pålsson and I am a PhD student at the World Maritime University. For my PhD thesis, I am examining the state of oil spill preparedness in Sweden, for oil spills at sea. The data collected will provide useful information regarding oil spill planning, response, organisation and management in Sweden.

Because you are involved in oil spill contingency preparedness in your organisation, I am inviting you to participate in this research study by completing an electronic survey. It will take around thirty minutes of your time. Participation is strictly voluntary and you may refuse to participate at any time. Your participation is much appreciated. There is no compensation for responding, but I hope that my findings will benefit oil spill preparedness in Sweden in general, by increasing the understanding and suggesting improvements.

I will keep all non-public information confidential and only the combined results of several interviews will be disclosed, not individual answers. The findings will be made available publicly.

The survey has been approved by the Research Ethics Committee of the World Maritime University. If you are not satisfied with the manner in which this study is being conducted, you may report (anonymously if

you so choose) any complaints to my supervisor, Professor Olof Lindén.

If you require additional information or have questions, please contact me.

Sincerely,
Jonas Pålsson

+46 709 45 51 32
jp@wmu.se

Professor
Olof Lindén
+46 40-35 63 30
ol@wmu.se

1) Do you agree these terms and would like to participate in this survey?*

( ) Yes

( ) No

Participant information

This section asks basic questions about the participant.

2) Name*

____

3) Organisation*

____

4) Position*

____

5) Telephone*

____

6) Email*

____

7) What percent of your work time is dedicated to oil spill preparedness issues?

____

8) In what capacity do you work with oil spill preparedness issues?

____
____
____
____

Thank you for providing valuable information about yourself! Let's begin with questions on planning, before moving on to response, management and concluding questions.

Definitions

These questions are limited to oil spills originating from spills originating from vessels at sea and end up on land. The time ranges from the planning phase to the initial response phase, but does not include the long term clean-up phase.

Oil spill preparedness
This includes all oil spill related issues, relating to risk assessments, sensitivity mapping, contingency planning, response, equipment, exercises, monitoring, environmental impact and claims.

Oil spill contingency planning
Only includes issues related to risk assessments, sensitivity mapping and contingency planning.
Excludes issues related to response, equipment, exercises, monitoring, environmental impact and claims.

Oil spill response
Only includes issues related to response, equipment, exercises, monitoring, environmental impact and claims.
Excludes issues related to risk assessments, sensitivity mapping and contingency planning.

Planning questions

This section asks questions about the contingency planning part of the oil spill preparedness in Sweden. It includes issues related to risk assessments, sensitivity mapping and contingency planning and excludes issues related to response, equipment, exercises, monitoring, environmental impact and claims.

9) Does your organisation have a formal responsibility for oil spill contingency planning?

( ) Yes

( ) No

Comments:

Logic: Hidden unless: Question "Does your organisation have a formal responsibility for oil spill contingency planning?" #9 is one of the following answers ("Yes")

10) What is your organisation's responsibility for oil spill contingency planning?

____

____

____

____

11) Which of the following organisations does your organisation work with on oil spill contingency planning?

[ ] Swedish Coast Guard

[ ] Swedish Civil Contingencies Agency

[ ] Swedish Oil Spill Equipment Depot:: ____

[ ] Swedish Agency for Marine and Water Management

[ ] Swedish Oil Spill On-call Service

[ ] Swedish Environmental Protection Agency

[ ] Swedish Maritime Administration

[ ] Swedish Transport Agency

[ ] Swedish Armed Forces

[ ] County Administrative Boards:: ____

[ ] Municipalities:: ____

[ ] Volunteer organisations:: ____

[ ] Industries:: ____

[ ] Others:: ____

Comments:

12) Does your organisation have an oil spill contingency plan?

( ) Yes

( ) No

Comments:

Logic: Hidden unless: Question "Does your organisation have an oil spill contingency plan?" #12 is one of the following answers ("Yes")

13) What year was this oil spill contingency plan written?

____

Comments:

Logic: Hidden unless: Question "Does your organisation have an oil spill contingency plan?" #12 is one of the following answers ("Yes")

14) What years were this oil spill contingency plan last revised?

	Year
Revision	____
Revision	____
Revision	____

Comments:

Logic: Hidden unless: Question "Does your organisation have an oil spill contingency plan?" #12 is one of the following answers ("Yes")

15) Is this oil spill contingency plan shared with other organisations?

( ) Yes

( ) No

Comments:

Logic: Hidden unless: Question "Is this oil spill contingency plan shared with other organisations?" #15 is one of the following answers ("Yes")

16) With which organisations is this oil spill contingency plan shared, why is it shared and how?

	Name
Organisation	____
Organisation	____
Organisation	____

Comments:

17) Does your organisation have a risk assessment for oil spills?

( ) Yes

( ) No

Comments:

Logic: Hidden unless: Question "Does your organisation have a risk assessment for oil spills?" #17 is one of the following answers ("Yes")

18) In what year was the risk assessment written?

____

Comments:

Logic: Hidden unless: Question "Does your organisation have a risk assessment for oil spills?" #17 is one of the following answers ("Yes")

19) In what years were the risk assessment last revised?

	Year
Revision	____
Revision	____
Revision	____

Comments:

20)

Several organisations are involved with oil spill planning in various ways and their impact to your organisation in oil spill contingency planning may differ.

Please identify how valuable you consider these organisations to be in assisting with your oil spill contingency planning (NOT for oil spill response)?

	Not valuable	**Limited value**	**Average value**	**Valuable**	**Very valuable**	**No opinion**
Swedish Coast Guard	( )	( )	( )	( )	( )	( )
Swedish Civil Contingencies Agency	( )	( )	( )	( )	( )	( )

Swedish Oil Spill Equipment Depots	( )	( )	( )	( )	( )	( )
Swedish Agency for Marine and Water Management	( )	( )	( )	( )	( )	( )
Swedish Oil Spill On-call Service	( )	( )	( )	( )	( )	( )
Swedish Environmental Protection Agency	( )	( )	( )	( )	( )	( )
Swedish Maritime Administration	( )	( )	( )	( )	( )	( )
Swedish Transport Agency	( )	( )	( )	( )	( )	( )
Swedish Armed Forces	( )	( )	( )	( )	( )	( )
County Administrative Boards	( )	( )	( )	( )	( )	( )
Municipalities	( )	( )	( )	( )	( )	( )
Volunteer organisations	( )	( )	( )	( )	( )	( )
Industry	( )	( )	( )	( )	( )	( )
Others	( )	( )	( )	( )	( )	( )

Comments:

21) Some organisations have different responsibilities and priorities for oil spill contingency planning. This responsibility may not correspond to the expectations of the other organisations involved.

What level of responsibility do you think these organisations should have in oil spill contingency planning, compared to today?

	No responsibility	Greatly decreased	Slightly decreased	Same as now	Slightly increased	Greatly increased
Swedish Coast Guard	( )	( )	( )	( )	( )	( )
Swedish Civil Contingencies Agency	( )	( )	( )	( )	( )	( )
Swedish Oil Spill Equipment Depots	( )	( )	( )	( )	( )	( )
Swedish Agency for Marine and Water Management	( )	( )	( )	( )	( )	( )
Swedish Oil Spill On-call Service	( )	( )	( )	( )	( )	( )
Swedish Environmental Protection Agency	( )	( )	( )	( )	( )	( )
Swedish Maritime Administration	( )	( )	( )	( )	( )	( )
Swedish Transport Agency	( )	( )	( )	( )	( )	( )

Swedish Armed Forces	( )	( )	( )	( )	( )	( )
County Administrative Boards	( )	( )	( )	( )	( )	( )
Municipalities	( )	( )	( )	( )	( )	( )
Volunteer organisations	( )	( )	( )	( )	( )	( )
Industry	( )	( )	( )	( )	( )	( )
Others	( )	( )	( )	( )	( )	( )

Comments:

22) Do you think there is a risk for an oil spill (1,000 tonnes or more) in your geographic area of jurisdiction between 2015 and 2025?

( ) Yes

( ) No

Logic: Hidden unless: Question "Do you think there is a risk for an oil spill (1,000 tonnes or more) in your geographic area of jurisdiction between 2015 and 2025?" #22 is one of the following answers ("Yes")

23) Why do you think there is a risk for an oil spill between 2015 and 2025?

____

____

____

____

Logic: Hidden unless: Question "Do you think there is a risk for an oil spill (1,000 tonnes or more) in your geographic area of jurisdiction between 2015 and 2025?" #22 is one of the following answers ("No")

24) Why do you think there is no risk for an oil spill between 2015 and 2025?

____

____

____

____

Thank you for providing valuable information about planning!

Let's continue with questions on response, before moving on to management and concluding questions.

Response questions

This section asks questions about the response part of the oil spill preparedness in Sweden. It includes issues related to response, equipment, exercises, monitoring, environmental impact and claims and excludes issues related to risk assessments, sensitivity mapping and contingency planning.

25) Does your organisation have a formal responsibility for oil spill response?

( ) Yes

( ) No

Comments:

Logic: Hidden unless: Question "Does your organisation have a formal responsibility for oil spill response?" #25 is one of the following answers ("Yes")

26) What is your organisation's responsibility for oil spill response?

____

____

____

____

27) Which organisations does your organisation work with on oil spill response?

[ ] Swedish Coast Guard

[ ] Swedish Civil Contingencies Agency

[ ] Swedish Oil Spill Equipment Depot:: ____

[ ] Swedish Agency for Marine and Water Management

[ ] Swedish Oil Spill On-call Service

[ ] Swedish Environmental Protection Agency

[ ] Swedish Maritime Administration

[ ] Swedish Transport Agency

[ ] Swedish Armed Forces

[ ] County Administrative Boards:: ____

[ ] Municipalities:: ____

[ ] Volunteer organisations:: ____

[ ] Industries:: ____

[ ] Others:: ____

Comments:

28) Has your organisation participated in any oil spill exercises?

( ) Yes

( ) No

Comments:

Logic: Hidden unless: Question "Has your organisation participated in any oil spill exercises?" #28 is one of the following answers ("Yes")

29) What were the names, which years and what were the locations of the last exercises your organisation participated in?

	Name	
Exercise	____	______________________
Exercise	____	______________________
Exercise	____	______________________

Comments:

Logic: Hidden unless: Question "Has your organisation participated in any oil spill exercises?" #28 is one of the following answers ("Yes")

30) In what way were the exercises helpful to your organisation?

____

____

____

____

31) Several organisations are involved with oil spill response in various ways and their impact to your organisation in oil spill response may differ.

Please identify how valuable you consider these organisations to be in assisting with your oil spill response (NOT for oil spill contingency planning)?

	Not valuable	Limited value	Average value	Valuable	Very valuable	No opinion
Swedish Coast Guard	( )	( )	( )	( )	( )	( )
Swedish Civil Contingencies Agency	( )	( )	( )	( )	( )	( )
Swedish Oil Spill Equipment Depots	( )	( )	( )	( )	( )	( )
Swedish Agency for Marine and Water Management	( )	( )	( )	( )	( )	( )
Swedish Oil Spill On-call Service	( )	( )	( )	( )	( )	( )
Swedish Environmental Protection Agency	( )	( )	( )	( )	( )	( )
Swedish Maritime Administration	( )	( )	( )	( )	( )	( )
Swedish Transport Agency	( )	( )	( )	( )	( )	( )
Swedish Armed Forces	( )	( )	( )	( )	( )	( )
County Administrative Boards	( )	( )	( )	( )	( )	( )
Municipalities	( )	( )	( )	( )	( )	( )

Volunteer organisations	( )	( )	( )	( )	( )	( )
Industry	( )	( )	( )	( )	( )	( )
Others	( )	( )	( )	( )	( )	( )

Comments:

32) Some organisations have different responsibilities and priorities for oil spill response. This responsibility may not correspond to the expectations of the other organisations involved.

What level of responsibility do you think these organisations should have in oil spill response, compared to today?

	No responsibility	**Greatly decreased**	**Slightly decreased**	**Same as now**	**Slightly increased**	**Greatly increased**
Swedish Coast Guard	( )	( )	( )	( )	( )	( )
Swedish Civil Contingencies Agency	( )	( )	( )	( )	( )	( )
Swedish Oil Spill Equipment Depots	( )	( )	( )	( )	( )	( )
Swedish Agency for Marine and Water Management	( )	( )	( )	( )	( )	( )
Swedish Oil Spill On-call Service	( )	( )	( )	( )	( )	( )

Swedish Environmental Protection Agency	( )	( )	( )	( )	( )	( )
Swedish Maritime Administration	( )	( )	( )	( )	( )	( )
Swedish Transport Agency	( )	( )	( )	( )	( )	( )
Swedish Armed Forces	( )	( )	( )	( )	( )	( )
County Administrative Boards	( )	( )	( )	( )	( )	( )
Municipalities	( )	( )	( )	( )	( )	( )
Volunteer organisations	( )	( )	( )	( )	( )	( )
Industry	( )	( )	( )	( )	( )	( )
Others	( )	( )	( )	( )	( )	( )

Comments:

33) Exercises are considered an important part of oil spill preparedness. They can range from simple tabletop exercises to full deployment exercises. Tabletop exercises tests the communication channels and decision making of the oil spill response personnel.

How often do you think Sweden needs to conduct *tabletop* exercises for oil spills at different levels?

	Never	**Less than once**	**Once every 4-5**	**Once every 2-3**	**Once per year**	**More than once**	**No opinion**

		every 5th year	years	years		per year	
International tabletop exercises	( )	( )	( )	( )	( )	( )	( )
National tabletop exercises	( )	( )	( )	( )	( )	( )	( )
County tabletop exercises	( )	( )	( )	( )	( )	( )	( )
Municipal tabletop exercises	( )	( )	( )	( )	( )	( )	( )

Comments:

34) A full deployment exercise tests the equipment to be used in a real spill and how well the personnel can handle the equipment, in addition to communication and decision making.

How often do you think Sweden needs to conduct *full deployment* exercises for oil spills at different levels?

	Never	Less than once every 5th year	Once every 4-5 years	Once every 2-3 years	Once per year	More than once per year	No opinion
International deployment exercises	( )	( )	( )	( )	( )	( )	( )
National deployment	( )	( )	( )	( )	( )	( )	( )

exercises							
County deployment exercises	( )	( )	( )	( )	( )	( )	( )
Municipal deployment exercises	( )	( )	( )	( )	( )	( )	( )

Comments:

Thank you for providing valuable information about response!

Let's continue with questions on management, before moving on to concluding questions.

Management questions

This section asks questions about the organisation, management and communication part of the oil spill preparedness in Sweden. Oil spill preparedness includes all oil spill related issues, relating to risk assessments, sensitivity mapping, contingency planning, response, equipment, exercises, monitoring, environmental impact and claims.

35) Has any strategy or policy documents made your organisation prioritise oil spill preparedness more between 2010 and 2015, compared to before?

( ) Yes

( ) No

Comments:

Logic: Hidden unless: Question "Has any strategy or policy documents made your organisation prioritise oil spill preparedness more between 2010 and 2015, compared to before?" #35 is one of the following answers ("Yes")

36) What are the names of the strategy or policy documents?

	Name
Document	____
Document	____
Document	____

Comments:

37) How has the work load for oil spill preparedness changed in your organisation between 2010 and 2015?

( ) Decreased greatly

( ) Decreased slightly

( ) Remains the same

( ) Increased slightly

( ) Increased greatly

Comments:

38) How has the budget for oil spill preparedness changed in your organisation between 2010 and 2015?

( ) Decreased greatly

( ) Decreased slightly

( ) Remains the same

( ) Increased slightly

( ) Increased greatly

Comments:

39) How has the allocated staff for oil spill preparedness changed in your organisation between 2010 and 2015?

( ) Decreased greatly

( ) Decreased slightly

( ) Remains the same

( ) Increased slightly

( ) Increased greatly

Comments:

40) Has your organisation been part of any external oil spill project?

( ) Yes

( ) No

Logic: Hidden unless: Question "Has your organisation been part of any external oil spill project?" #40 is one of the following answers ("Yes")

41) Which external oil spill projects has your organisation been part of, when were the projects and how were they funded?

	Name	**Y**
Project	____	______________________
Project	____	______________________
Project	____	______________________

Comments:

Logic: Hidden unless: Question "Has your organisation been part of any external oil spill project?" #40 is one of the following answers ("Yes")

42) In what way was the projects helpful to your organisation?

____

____

____

____

43) This statement addresses the formal roles and division of responsibilities between different organisations in the organisational structure of oil spill preparedness in Sweden. The roles could be widely known or they could be virtually unknown to other organisations.

How do you agree with the statement "The role of this organisation in oil spill preparedness is well understood by the others."?

	Strongly disagree	**Disagree**	**No opinion**	**Agree**	**Strongly agree**
Swedish Coast Guard	( )	( )	( )	( )	( )
Swedish Civil Contingencies Agency	( )	( )	( )	( )	( )
Swedish Oil Spill Equipment Depots	( )	( )	( )	( )	( )
Swedish Agency for Marine and Water Management	( )	( )	( )	( )	( )

Swedish Oil Spill On-call Service	( )	( )	( )	( )	( )
Swedish Environmental Protection Agency	( )	( )	( )	( )	( )
Swedish Maritime Administration	( )	( )	( )	( )	( )
Swedish Transport Agency	( )	( )	( )	( )	( )
Swedish Armed Forces	( )	( )	( )	( )	( )
County Administrative Boards	( )	( )	( )	( )	( )
Municipalities	( )	( )	( )	( )	( )
Volunteer organisations	( )	( )	( )	( )	( )
Industry	( )	( )	( )	( )	( )
Others	( )	( )	( )	( )	( )

Comments:

44) Good communication can be a very limiting factor in oil spill preparedness. This question addresses the flow of information between different organisations. Directions means orders that you are obliged to follow and recommendations means advice that would be beneficial to heed, but you are not required to do so.

How do you communicate with these organisations about oil spill preparedness?

	We don't communicate	They give us directions	They give us recommendations	We discuss	We give the recommendat
Swedish Coast Guard	( )	( )	( )	( )	( )
Swedish Civil Contingencies Agency	( )	( )	( )	( )	( )
Swedish Oil Spill Equipment Depots	( )	( )	( )	( )	( )
Swedish Agency for Marine and Water Management	( )	( )	( )	( )	( )
Swedish Oil Spill On-call Service	( )	( )	( )	( )	( )
Swedish Environmental Protection Agency	( )	( )	( )	( )	( )
Swedish Maritime Administration	( )	( )	( )	( )	( )
Swedish Transport Agency	( )	( )	( )	( )	( )
Swedish Armed Forces	( )	( )	( )	( )	( )
County Administrative Boards	( )	( )	( )	( )	( )
Municipalities	( )	( )	( )	( )	( )

Volunteer organisations	( )	( )	( )	( )	( )
Industry	( )	( )	( )	( )	( )
Others	( )	( )	( )	( )	( )

Comments:

Thank you for providing valuable information about management!

Let's finish with some concluding questions.

Concluding questions

This section asks questions about the Baltic Maritime Science Park Oil Spill Forum and general issues of the oil spill preparedness in Sweden.

45) Have you heard about the Baltic Maritime Science Park Oil Spill Forum?

( ) Yes

( ) No

Comments:

Logic: Hidden unless: Question "Have you heard about the Baltic Maritime Science Park Oil Spill Forum?" #45 is one of the following answers ("Yes")

46) How did you first hear about the Baltic Maritime Science Park Oil Spill Forum?

( ) Colleague

( ) Project

( ) Course

( ) Internet

( ) Other: ____

Comments:

Logic: Hidden unless: Question "Have you heard about the Baltic Maritime Science Park Oil Spill Forum?" #45 is one of the following answers ("Yes")

47) Have you visited the Baltic Maritime Science Park Oil Spill Forum?

( ) Yes

( ) No

Comments:

Logic: Hidden unless: Question "Have you heard about the Baltic Maritime Science Park Oil Spill Forum?" #45 is one of the following answers ("No")

The Baltic Maritime Science Park oil spill forum is a webpage that collects information from oil spill preparedness projects in the Baltic Sea and displays oil spill news at www.bmsp.se.

48) Please list topics that you believe to be essential to have easy access to for oil spill preparedness?

Topic: ____

Topic: ____

Topic: ____

Topic: ____

Topic: ____

Comments:

49) Two of the latest oil spills from ships has been the *Fu Shan Hai* outside Ystad in 2003 and the *Golden Trader* that impacted Tjörn 2011. These vessels spilled roughly 1,000 tonnes of oil.

Do you think your organisation's geographic area of jurisdiction is prepared to handle an oil spill of 1,000 tonnes?

( ) Yes

( ) No

Logic: Hidden unless: Question "Two of the latest oil spills from ships has been the *Fu Shan Hai* outside Ystad in 2003 and the *Golden Trader* that impacted Tjörn 2011. These vessels spilled roughly 1,000 tonnes of oil.

Do you think your organisation's geographic area of jurisdiction is prepared to handle an oil spill of 1,000 tonnes?" #49 is one of the following answers ("Yes")

50) Why do you think your organisation's area is prepared to handle an oil spill of 1,000 tonnes?

____

____

____

____

Logic: Hidden unless: Question "Two of the latest oil spills from ships has been the *Fu Shan Hai* outside Ystad in 2003 and the *Golden Trader* that impacted Tjörn 2011. These vessels spilled roughly 1,000 tonnes of oil.

Do you think your organisation's geographic area of jurisdiction is prepared to handle an oil spill of 1,000 tonnes?" #49 is one of the following answers ("No")

51) Why do you think your organisation's area is not prepared to handle an oil spill of 1,000 tonnes?

____

____

____

____

52) In a strategic document about Swedish oil spill preparedness for 2010 written by the Swedish Rescue Agency, the goal that Sweden will be prepared to handle an oil spill of 10,000 tonnes by the year 2010 is outlined.

Do you think your organisation's geographic area of jurisdiction is prepared to handle an oil spill of 10,000 tonnes?

( ) Yes

( ) No

Logic: Hidden unless: Question "In a strategic document about Swedish oil spill preparedness for 2010 written by the Swedish Rescue Agency, the goal that Sweden will be prepared to handle an oil spill of 10,000 tonnes by the year 2010 is outlined.

Do you think your organisation's geographic area of jurisdiction is prepared to handle an oil spill of 10,000 tonnes?" #52 is one of the following answers ("Yes")

53) Why do you think your organisation's area is prepared to handle an oil spill of 10,000 tonnes?

____

____

____

____

Logic: Hidden unless: Question "In a strategic document about Swedish oil spill preparedness for 2010 written by the Swedish Rescue Agency, the goal that Sweden will be prepared to handle an oil spill of 10,000 tonnes by the year 2010 is outlined.

Do you think your organisation's geographic area of jurisdiction is prepared to handle an oil spill of 10,000 tonnes?" #52 is one of the following answers ("No")

54) Why do you think your organisation's area is not prepared to handle an oil spill of 10,000 tonnes?

____

____

____

____

55) What do you think are the *most* limiting factors in Swedish oil spill preparedness?

____

____

____

____

56) What do you think are the *least* limiting factors in Swedish oil spill preparedness?

____

____

____

____

This is the end of the survey. Thank you for providing valuable information about oil spill preparedness in Sweden!

Thank You!

My sincerest thank you for taking my survey! The data collected will provide useful information about oil spill planning, response, organisation and management in Sweden and lead to advances in Swedish oil spill preparedness.

Best regards,
Jonas Pålsson

Appendix B - Interview

Interview questions used on the oil spill experts interviewed during January 2015.

Oil spill preparedness in Sweden - Interview

Introduction

3/12-2014

Dear Participant,

My name is Jonas Pålsson and I am a PhD student at the World Maritime University. For my PhD thesis, I am examining the state of oil spill preparedness in Sweden. The data collected will provide useful information regarding oil spill planning, response, organisation and management in Sweden.

Because you are a member of the Swedish National Coordination Group for Oil Spill Preparedness, I am inviting you to participate in this research study by allowing me to interview you on this topic. The interview will take around one hour of your time and preferably be conducted in person or over Skype or telephone. Participation is strictly voluntary and you may refuse to participate at any time. Your participation is much appreciated.

There is no compensation for responding, but I hope that my findings will benefit oil spill preparedness in Sweden in general, by increasing the understanding and suggesting improvements.

I will keep all non-public information confidential and only the combined results of several interviews will be disclosed, not individual answers. The findings will be made available publicly.

The survey has been approved by the Research Ethics Committee of the World Maritime University. If you are not satisfied with the manner in which this study is being conducted, you may report (anonymously if you so choose) any complaints to my supervisor, Professor Olof Lindén.

If you require additional information or have questions, please contact me.

Sincerely,
Jonas Pålsson

+46 709 45 51 32
jp@wmu.se

Professor
Olof Lindén
+46 40-35 63 30
ol@wmu.se

Participant information

1) Name*

____

2) Organisation

____

3) Email*

____

Definitions

These questions are limited to oil spills originating from spills originating from vessels at sea and end up on land. The time ranges from the planning phase to the initial response phase, but does not include the long term clean-up phase.

Oil spill preparedness
This includes all oil spill related issues, relating to risk assessments, sensitivity

mapping, contingency planning, response, equipment, exercises, monitoring, environmental impact and claims.

Oil spill contingency planning
Only includes issues related to risk assessments, sensitivity mapping and contingency planning.
Excludes issues related to response, equipment, exercises, monitoring, environmental impact and claims.

Oil spill response
Only includes issues related to response, equipment, exercises, monitoring, environmental impact and claims.
Excludes issues related to risk assessments, sensitivity mapping and contingency planning.

Planning questions

4) How do you agree with the statement "The existing system for contingency planning in Sweden is sufficient for the national preparedness." and why?

( ) Strongly disagree

( ) Disagree

( ) No opinion

( ) Agree

( ) Strongly agree

Comments:

5) How do you agree with the statement "Sweden needs of a national oil spill contingency plan." and why?

( ) Strongly disagree

( ) Disagree

( ) No opinion

( ) Agree

( ) Strongly agree

Comments:

6) How do you agree with the statement "Sweden needs a coastal environmental sensitivity map." and why?

( ) Strongly disagree

( ) Disagree

( ) No opinion

( ) Agree

( ) Strongly agree

Comments:

Response question

7) How do you agree with the statement "Sweden sufficiently addresses the problems identified in the oil spill response exercise evaluations." and why?

( ) Strongly disagree

( ) Disagree

( ) No opinion

( ) Agree

( ) Strongly agree

Comments:

Management questions

8) How do you agree with the statement "Swedish oil spill *preparedness* is effectively *organised*." and why?

( ) Strongly disagree

( ) Disagree

( ) No opinion

( ) Agree

( ) Strongly agree

Comments:

9) How do you agree with the statement "Swedish oil spill *contingency planning* is effectively *managed*." and why?

( ) Strongly disagree

( ) Disagree

( ) No opinion

( ) Agree

( ) Strongly agree

Comments:

10) How do you agree with the statement "Swedish oil spill *response* is effectively *managed*." and why?

( ) Strongly disagree

( ) Disagree

( ) No opinion

( ) Agree

( ) Strongly agree

Comments:

11) What role would you prefer your organisation to have in oil spill preparedness and why?

____

____

____

____

International questions

12) Have you worked with (including as observer) oil spills outside of Sweden?

( ) Yes

( ) No

Logic: Hidden unless: Question "Have you worked with (including as observer) oil spills outside of Sweden?" #12 is one of the following answers ("Yes")

13) How many oil spills have you worked with (including as observer) outside of Sweden and in what capacity?

____

Comments:

Logic: Hidden unless: Question "Have you worked with (including as observer) oil spills outside of Sweden?" #12 is one of the following answers ("Yes")

14) In which countries outside of Sweden did you work with oil spills (including as observer)?

____

____

____

____

15) Have you participated in oil spill exercises (including as observer) outside of Sweden?

( ) Yes

( ) No

Logic: Hidden unless: Question "Have you participated in oil spill exercises (including as observer) outside of Sweden?" #15 is one of the following answers ("Yes")

16) How many oil spill exercises have you participated in (including as observer) outside of Sweden and in what capacity?

____

Comments:

Logic: Hidden unless: Question "Have you participated in oil spill exercises (including as observer) outside of Sweden?" #15 is one of the following answers ("Yes")

17) In which countries outside of Sweden did you participate in oil spill exercises (including as observer)?

____

____

____

____

18) How do you agree with the statement "Swedish oil spill preparedness is equivalent to international standard." and why?

( ) Strongly disagree

( ) Disagree

( ) No opinon

( ) Agree

( ) Strongly agree

Comments:

Thank You!

My sincerest thank you for taking part in this interview! The data collected will provide useful information about oil spill planning, response, organisation and management in Sweden and lead to advances in Swedish oil spill preparedness.

Best regards,
Jonas Pålsson

Appendix C - Sendlist

List of emails addresses the questionnaire was sent to during 2014 and 2015.

County Administrative Boards

County	Name	Email
Blekinge	Jonas Hallbom	jonas.hallbom@lansstyrelsen.se
Gotland	Mats Lagerqvist	mats.lagerqvist@lansstyrelsen.se
Gävleborg	Torleif Michel	torleif.michel@lansstyrelsen.se
Halland	Catrin Käldman	catrin.kaldman@lansstyrelsen.se
Jönköping	Börje Karlsson	borje.n.karlsson@lansstyrelsen.se
Kalmar	Sigge Sundström	sigge.sundstrom@lansstyrelsen.se
Norrbotten	Micael Bredefeldt	micael.bredefeldt@lansstyrelsen.se
Skåne	Lars Persson	lars.persson@lansstyrelsen.se
Stockholm	Göran Dalin	goran.dalin@lansstyrelsen.se
Södermanland	Tomas Birgegård	tomas.birgegard@lansstyrelsen.se
Uppsala	Anders Leijon	anders.leijon@lansstyrelsen.se
Värmland	Johan Olsson	johan.olsson@lansstyrelsen.se
Västerbotten	Patrik Nilsson	patrik.u.nilsson@lansstyrelsen.se
Västernorrland	Martin Neldén	martin.nelden@lansstyrelsen.se
Västmanland	Ingela Regnell	Ingela.Regnell@lansstyrelsen.se
Västra Götaland	Markus Green	markus.green@lansstyrelsen.se
Örebro	Marcus Sjöholm	marcus.sjoholm@lansstyrelsen.se
Östergötland	Carl Granström	carl.granstrom@lansstyrelsen.se

Municipalities

Municipality	County	Name	Organisation	Email
Ale	Västra Götaland	Fredrik Johansson	Bohus Räddningstjänstförbund	fredrik.johansson@borf.se
Askersund	Örebro	Anders Larsson	Nerikes Brandkår	anders.larsson@nerikesbrandkar.se
Borgholm	Kalmar	Bengt Andersson	Räddningstjänsten Öland	bengt.andersson@morbylanga.se
Botkyrka	Stockholm	Bo Björklund	Södertörns Brandförsvarsförbund	bo.bjorklund@sbff.se
Bromölla	Skåne	Sanja Vojnikovic	Bromölla kommun	sanja.vojnikovic@bromolla.se
Burlöv	Skåne	Torbjörn Krokström	Räddningstjänsten Syd	torbjorn.krokstrom@rsyd.se
Båstad	Skåne	Rolf Andreasson	Räddningstjänsten Båstad	rolf.andreasson@bastad.se
Danderyd	Stockholm	Lars Winberg	Danderyds kommun	lars.winberg@danderyd.se
Ekerö	Stockholm	Bo Björklund	Södertörns Brandförsvarsförbund	bo.bjorklund@sbff.se
Enköping	Uppsala	Maria Kanka	Enköpings kommun	maria.kanka@enkoping.se
Eskilstuna	Södermanland	Katarina Reigo	Eskilstuna kommun	katarina.reigo@eskilstuna.se
Falkenberg	Halland	Therese Jouper	Räddningstjänsten Väst	therese.jouper@rvast.se

Gotland	Gotland	Robert Hjalmarsson	Räddningstjänsten Gotland	robert.hjalmarsson@gotland.se
Grums	Värmland	Nils Weslien	Räddningstjänsten Karlstadsregionen	nils.weslien@karlstad.se
Grästorp	Västra Götaland	Anders Ydergren	Räddningstjänsten Västra Skaraborg	anders.ydergren@lidkoping.se
Gullspång	Västra Götaland	Daniele Coen	Räddningstjänsten Östra Skaraborg	daniele.coen@rtos.se
Gävle	Gävleborg	Tommy Törling	Gästrike Räddningstjänst	tommy.torling@gavle.se
Göteborg	Västra Götaland	Per Nyqvist	Räddningstjänsten Storgöteborg	per.nyqvist@rsgbg.se
Götene	Västra Götaland	Tommy Emriksson	Räddningstjänsten Skara-Götene	tommy.emriksson@skara.se
Habo	Jönköping	Kent Granberg	Habo kommun	kent.granberg@habokommun.se
Hallstahammar	Västmanland	Erik Mattsson	Mälardalens Brand- och Räddningsförbund	erik.mattsson@mbrf.se
Halmstad	Halland	Lars Fredin	Räddningstjänsten Halmstad	lars.fredin@halmstad.se
Hammarö	Värmland	Nils Weslien	Räddningstjänsten Karlstadsregionen	nils.weslien@karlstad.se
Haninge	Stockholm	Bo Björklund	Södertörns Brandförsvarsförbund	bo.bjorklund@sbff.se
Haparanda	Norrbotten	Anders Lindahl		anders.lindahl@haparanda.se
Helsingborg	Skåne	Jonas Nylén	Räddningstjänsten Skåne Nordväst	jonas.nylen@helsingborg.se
Hjo	Västra Götaland	Daniele Coen	Räddningstjänsten Östra Skaraborg	daniele.coen@rtos.se
Huddinge	Stockholm	Bo Björklund	Södertörns Brandförsvarsförbund	bo.bjorklund@sbff.se
Hudiksvall	Gävleborg	Lennart Juhlin	Norrhälsinge Räddningstjänst	lennart.juhlin@hudiksvall.se
Håbo	Uppsala	Louise Lightowler	Håbo kommun	louise.lightowler@habo.se
Härnösand	Västernorrland	Mats Granat	Räddningstjänsten Höga Kusten-Ådalen	mats.granat@hka.se
Höganäs	Skåne	Marcus Nilsson	Höganäs kommun	marcus.nilsson@hoganas.se
Järfälla	Stockholm	Bengt Engkvist	Järfälla kommun	bengt.engkvist@jarfalla.se
Jönköping	Jönköping	Göran Melin	Jönköpings räddningstjänst	goran.melin@jonkoping.se
Kalix	Norrbotten	Agneta Lipkin		agneta.Lipkin@kalix.se
Kalmar	Kalmar	Kalle Daleen	Kalmar kommun	karl-johan.daleen@kalmar.se
Karlsborg	Västra	Daniele	Räddningstjänsten Östra	daniele.coen@rtos.se

	Götaland	Coen	Skaraborg	
Karlshamn	Blekinge	Ulf Melander		ulf.melander@karlshamn.se
Karlskrona	Blekinge	Per Drysén		per.Drysen@olofstrom.se
Karlstad	Värmland	Nils Weslien	Räddningstjänsten Karlstadsregionen	nils.weslien@karlstad.se
Kramfors	Västernorrland	Mats Granat	Räddningstjänsten Höga Kusten-Ådalen	mats.granat@hka.se
Kristianstad	Skåne	Peter Zerpe	Räddningstjänsten Kristianstad	peter.zerpe@kristianstad.se
Kristinehamn	Värmland	Per Modin	Bergslagens Räddningstjänst	per.modin@brt.se
Kungsbacka	Halland	Per Nyqvist	Räddningstjänsten Storgöteborg	per.nyqvist@rsgbg.se
Kungsör	Västmanland	Lena Mäenpää	Västra Mälardalens Räddningstjänst	lena.maenpaa@vmkfb.se
Kungälv	Västra Götaland	Fredrik Johansson	Bohus Räddningstjänstförbund	fredrik.johansson@borf.se
Kävlinge	Skåne	Torbjörn Krokström	Räddningstjänsten Syd	torbjorn.krokstrom@rsyd.se
Köping	Västmanland	Lena Mäenpää	Västra Mälardalens Räddningstjänst	lena.maenpaa@vmkfb.se
Laholm	Halland	Elin Tallqvist	Räddningstjänsten Laholm	elin.tallqvist@laholm.se
Landskrona	Skåne	Hanna Johansson	Räddningstjänsten Landskrona	hanna.i.johansson@landskrona.se
Lidingö	Stockholm	Fredrik Letzler	Storstockholms brandförsvar	fredrik.letzler@ssbf.brand.se
Lidköping	Västra Götaland	Anders Ydergren	Räddningstjänsten Västra Skaraborg	anders.ydergren@lidkoping.se
Lomma	Skåne	Anders Åkesson	Lomma kommun	anders.akesson@lomma.se
Luleå	Norrbotten	Urban Rönnbäck	Luleå kommun	urban.ronnback@rtj.lulea.se
Lysekil	Västra Götaland	Mikael Gard		mikael.gard@uddevalla.se
Malmö	Skåne	Torbjörn Krokström	Räddningstjänsten Syd	torbjorn.krokstrom@rsyd.se
Mariestad	Västra Götaland	Daniele Coen	Räddningstjänsten Östra Skaraborg	daniele.coen@rtos.se
Mellerud	Västra Götaland	Tomas Sunnerdahl	Norra Älvsborgs Räddningstjänstförbund	tomas.sunnerdahl@brand112.se
Motala	Östergötland	Henrik Josefsson	Räddningstjänsten Motala-Vadstena	henrik.josefsson@motala.se
Munkedal	Västra Götaland	Mikael Gard		mikael.gard@uddevalla.se
Mönsterås	Kalmar	Ingemar Idh	Mönsterås kommun	ingemar.idh@monsteras.se
Mörbylånga	Kalmar	Bengt Andersson	Räddningstjänsten Öland	bengt.andersson@morbylanga.se

Nacka	Stockholm	Per Höglund		per.hoglund@nacka.se
Nordanstig	Gävleborg	Lennart Juhlin	Norrhälsinge Räddningstjänst	lennart.juhlin@hudiksvall.se
Nordmaling	Västerbotten	Jörgen Forslund		jorgen.forslund@nordmaling.se
Norrköping	Östergötland	Samuel Andersson	Räddningstjänsten Östra Götaland	samuel.andersson@rtog.se
Norrtälje	Stockholm	Ola Andersson		ola.andersson@norrtalje.se
Nykvarn	Stockholm	Bo Björklund	Södertörns Brandförsvarsförbund	bo.bjorklund@sbff.se
Nyköping	Södermanland	Benny Svensson	Sörmlandskustens Räddningstjänst	benny.svensson@nykoping.se
Nynäshamn	Stockholm	Kenneth Kollberg	Nynäshamns kommun	kenneth.kollberg@nynashamn.se
Orust	Västra Götaland	Marcus Larsson	Räddningstjänsten Orust	marcus.larsson2@orust.se
Oskarshamn	Kalmar	Lars Blomberg	Räddningstjänsten Oskarshamn	lars.blomberg@oskarshamn.se
Oxelösund	Södermanland	Benny Svensson	Sörmlandskustens Räddningstjänst	benny.svensson@nykoping.se
Piteå	Norrbotten	Linda Sjölund	Räddningstjänsten Piteå	linda.sjolund@pitea.se
Robertsfors	Västerbotten	Lars Tapani	Umeå kommun	lars.tapani@umea.se
Ronneby	Blekinge	Per Drysén		per.Drysen@olofstrom.se
Salem	Stockholm	Bo Björklund	Södertörns Brandförsvarsförbund	bo.bjorklund@sbff.se
Sigtuna	Stockholm	Bengt Engkvist	Järfälla kommun	bengt.engkvist@jarfalla.se
Simrishamn	Skåne	Mats Svensson	Sydöstra Skånes Räddningstjänstförbund	mats.svensson@sorf.se
Skellefteå	Västerbotten	Mattias Hagelin	Räddningstjänsten i Skellefteå kommun	mattias.hagelin@skelleftea.se
Skurup	Skåne	Mats Svensson	Sydöstra Skånes Räddningstjänstförbund	mats.svensson@sorf.se
Sollentuna	Stockholm	Bengt Engkvist	Järfälla kommun	bengt.engkvist@jarfalla.se
Solna	Stockholm	Fredrik Letzler	Storstockholms brandförsvar	fredrik.letzler@ssbf.brand.se
Sotenäs	Västra Götaland	Sandra Ylinenpää		sandra.ylinenpaa@sotenas.se
Stenungsund	Västra Götaland	Göran Andtbacka		goran.andtbacka@stenungsund.se
Stockholm	Stockholm	Fredrik Letzler	Storstockholms brandförsvar	fredrik.letzler@ssbf.brand.se
Strängnäs	Västmanland	Annica Strandberg	Strängnäs kommun	annica.strandberg@strangnas.se

Strömstad	Västra Götaland	Peter Birgersson Dafteryd	Strömstad kommun	peter.birgersson.dafteryd@stromstad.se
Sundbyberg	Stockholm	Fredrik Letzler	Storstockholms brandförsvar	fredrik.letzler@ssbf.brand.se
Sundsvall	Västernorrland	Tomas Öhrn	Räddningstjänsten Medelpad	tomas.ohrn@sundsvall.se
Säffle	Värmland	Mattias Larsson	Räddningsledning Säffle, Arvika, Eda	mattias.larsson@arvika.se
Söderhamn	Gävleborg	Michael Lindberg	Räddningstjänsten Södra Hälsingland	michael.lindberg@kfsh.se
Söderköping	Östergötland	Samuel Andersson	Räddningstjänsten Östra Götaland	samuel.andersson@rtog.se
Södertälje	Stockholm	Bo Björklund	Södertörns Brandförsvarsförbund	bo.bjorklund@sbff.se
Sölvesborg	Blekinge	Per Drysén		per.Drysen@olofstrom.se
Tanum	Västra Götaland	Göran Gustavsson		goeran.gustavsson@tanum.se
Tierp	Uppsala	Lars-Erik Falk	Östhammars kommun	lars-erik.falk@osthammar.se
Timrå	Västernorrland	Tomas Öhrn	Räddningstjänsten Medelpad	tomas.ohrn@sundsvall.se
Tjörn	Västra Götaland	Patrick Sällinen	Tjörns kommun	patrick.sallinen@tjorn.se
Torsås	Kalmar	Hans Erlandsson	Räddningstjänstförbundet Emmaboda-Torsås	hans.erlandsson@rfet.se
Trelleborg	Skåne	Måns Krook		mans.krook@trelleborg.se
Trosa	Södermanland	Benny Svensson	Sörmlandskustens Räddningstjänst	benny.svensson@nykoping.se
Tyresö	Stockholm	Kenneth Kollberg	Nynäshamns kommun	kenneth.kollberg@nynashamn.se
Täby	Stockholm	Fredrik Letzler	Storstockholms brandförsvar	fredrik.letzler@ssbf.brand.se
Uddevalla	Västra Götaland	Mikael Gard		mikael.gard@uddevalla.se
Umeå	Västerbotten	Lars Tapani	Umeå kommun	lars.tapani@umea.se
Upplands Väsby	Stockholm	Bengt Engkvist	Järfälla kommun	bengt.engkvist@jarfalla.se
Upplands-Bro	Stockholm	Tomas Wrådhe	Brandkåren Attunda	tomas.wradhe@brandkaren-attunda.se
Vadstena	Östergötland	Henrik Josefsson	Räddningstjänsten Motala-Vadstena	henrik.josefsson@motala.se
Valdemarsvik	Östergötland	Samuel Andersson	Räddningstjänsten Östra Götaland	samuel.andersson@rtog.se
Varberg	Halland	Therese Jouper	Räddningstjänsten Väst	therese.jouper@rvast.se
Vaxholm	Stockholm	Fredrik Letzler	Storstockholms brandförsvar	fredrik.letzler@ssbf.brand.se

Vellinge	Skåne	Måns Krook		mans.krook@trelleborg.se
Vänersborg	Västra Götaland	Tomas Sunnerdahl	Norra Älvsborgs Räddningstjänstförbund	tomas.sunnerdahl@brand112.se
Värmdö	Stockholm	Fredrik Letzler	Storstockholms brandförsvar	fredrik.letzler@ssbf.brand.se
Västervik	Kalmar	Peter Helge	Västerviks kommun	peter.helge@vastervik.se
Västerås	Västmanland	Erik Mattsson	Mälardalens Brand- och Räddningsförbund	erik.mattsson@mbrf.se
Ystad	Skåne	Mats Svensson	Sydöstra Skånes Räddningstjänstförbund	mats.svensson@sorf.se
Åmål	Västra Götaland	Tommy Kihlberg	Räddningstjänsten Åmål	tommy.kihlberg@amal.se
Älvkarleby	Uppsala	Martin Nilsson		martin.nilsson@alvkarleby.se
Ängelholm	Skåne	Jonas Nylén	Räddningstjänsten Skåne Nordväst	jonas.nylen@helsingborg.se
Öckerö	Västra Götaland	Jan-Eric Bäck	Öckerö kommun	jan-eric.back@ockero.se
Ödeshög	Östergötland	Jörgen Nielsen	Räddningstjänsten Ödeshög	jorgen.nielsen@odeshog.se
Örnsköldsvik	Västernorrland	Mats Renning	Räddningstjänsten Örnsköldsvik	mats.renning@ornskoldsvik.se
Österåker	Stockholm	Fredrik Letzler	Storstockholms brandförsvar	fredrik.letzler@ssbf.brand.se
Östhammar	Uppsala	Lars-Erik Falk	Östhammars kommun	lars-erik.falk@osthammar.se

Appendix D - Letters of Consent

Letters of consent from the oil spill experts interviewed during January 2015.

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Oljeskadeskyddsberedskap i Sverige

16/12-2014

Kära deltagare,
Mitt namn är Jonas Pålsson och jag doktorerar på World Maritime University i Malmö. Till min avhandling undersöker jag oljeskadeskyddsberedskapen i Sverige för oljeolyckor till havs som drabbar kusten. Informationen som samlas in kommer att ge användbar information om planering, insats, organisation och ledning av oljeskadeskyddet i Sverige. Eftersom du är involverad i oljeskadeskyddsberedskap, bjuder jag in dig till att delta i denna undersökning genom att svara på denna enkät. Enkäten tar ungefär en halvtimme att fylla i. Deltagande är naturligtvis frivilligt och du kan dra dig ur när som helst, men ditt deltagande är högst uppskattat.

Ingen kompensation utgår för att deltaga, men jag hoppas att mina resultat kommer till nytta för oljeskadeskyddsberedskapen i Sverige, genom att öka förstelsen och rekommendera förändringar.

Insamlad information som inte är offentlig kommer att hållas konfidentiell och enbart resultatet i helhet kommer att göras tillgängligt, inte enstaka svar. Resultaten kommer att användas i min doktorsavhandling och göras tillgänglig genom vetenskapliga artiklar, konferenser och populärvetenskapliga artiklar.

Undersökningen har godkänts av den Vetenskapliga Etikkommittén på World Maritime University. Har du några problem eller frågor rörande undersökningen, kontakta då mig eller min handledare, professor Olof Lindén. Önskas ytterligare information, tveka då inte att kontakta mig.

Vänliga hälsningar,
Jonas Pålsson

0709-45 51 32
jp@wmu.se

Professor
Olof Lindén
040-35 63 30
ol@wmu.se

Godkänner du dessa villkor och skulle du vilja delta i undersökningen?

(X) Ja

( ) Nej

Datum och underskrift

2015-01-12

WORLD MARITIME UNIVERSITY

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Oljeskadeskyddsberedskap i Sverige

16/12-2014

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Vänliga hälsningar,
Jonas Pålsson

0709-45 51 32
jp@wmu.se

Professor
Olof Lindén
040-35 63 30
ol@wmu.se

Godkänner du dessa villkor och skulle du vilja delta i undersökningen?

(X) Ja

( ) Nej

Datum och underskrift

20/1-2015

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Oljeskadeskyddsberedskap i Sverige

16/12-2014

Kära deltagare,
Mitt namn är Jonas Pålsson och jag doktorerar på World Maritime University i Malmö. Till min avhandling undersöker jag oljeskadeskyddsberedskapen i Sverige för oljeolyckor till havs som drabbar kusten. Informationen som samlas in kommer att ge användbar information om planering, insats, organisation och ledning av oljeskadeskyddet i Sverige. Eftersom du är involverad i oljeskadeskyddsberedskap, bjuder jag in dig till att delta i denna undersökning genom att svara på denna enkät. Enkäten tar ungefär en halvtimme att fylla i. Deltagande är naturligtvis frivilligt och du kan dra dig ur när som helst, men ditt deltagande är högst uppskattat.

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Vänliga hälsningar,
Jonas Pålsson

0709-45 51 32
jp@wmu.se

Professor
Olof Lindén
040-35 63 30
ol@wmu.se

Godkänner du dessa villkor och skulle du vilja delta i undersökningen?

(X) Ja

( ) Nej

Datum och underskrift

15-01-22 [signature]

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Oljeskadeskyddsberedskap i Sverige

16/12-2014

Kära deltagare,
Mitt namn är Jonas Pålsson och jag doktorerar på World Maritime University i Malmö. Till min avhandling undersöker jag oljeskadeskyddsberedskapen i Sverige för oljeolyckor till havs som drabbar kusten. Informationen som samlas in kommer att ge användbar information om planering, insats, organisation och ledning av oljeskadeskyddet i Sverige. Eftersom du är involverad i oljeskadeskyddsberedskap, bjuder jag in dig till att delta i denna undersökning genom att svara på denna enkät. Enkäten tar ungefär en halvtimme att fylla i. Deltagande är naturligtvis frivilligt och du kan dra dig ur när som helst, men ditt deltagande är högst uppskattat.

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Vänliga hälsningar,
Jonas Pålsson

0709-45 51 32
jp@wmu.se

Professor
Olof Lindén
040-35 63 30
ol@wmu.se

Godkänner du dessa villkor och skulle du vilja delta i undersökningen?

(X) Ja

( ) Nej

Datum och underskrift

22/1 -15 [signature]

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Oljeskadeskyddsberedskap i Sverige

16/12-2014

Kära deltagare,
Mitt namn är Jonas Pålsson och jag doktorerar på World Maritime University i Malmö. Till min avhandling undersöker jag oljeskadeskyddsberedskapen i Sverige för oljeolyckor till havs som drabbar kusten. Informationen som samlas in kommer att ge användbar information om planering, insats, organisation och ledning av oljeskadeskyddet i Sverige. Eftersom du är involverad i oljeskadeskyddsberedskap, bjuder jag in dig till att delta i denna undersökning genom att svara på denna enkät. Enkäten tar ungefär en halvtimme att fylla i. Deltagande är naturligtvis frivilligt och du kan dra dig ur när som helst, men ditt deltagande är högst uppskattat.

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Undersökningen har godkänts av den Vetenskapliga Etikkommittén på World Maritime University. Har du några problem eller frågor rörande undersökningen, kontakta då mig eller min handledare, professor Olof Lindén. Önskas ytterligare information, tveka då inte att kontakta mig.

Vänliga hälsningar,
Jonas Pålsson

0709-45 51 32
jp@wmu.se

Professor
Olof Lindén
040-35 63 30
ol@wmu.se

Godkänner du dessa villkor och skulle du vilja delta i undersökningen?
(X) Ja
( ) Nej

Datum och underskrift

23/1 2015 [signature]

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Oljeskadeskyddsberedskap i Sverige

16/12-2014

Kära deltagare,
Mitt namn är Jonas Pålsson och jag doktorerar på World Maritime University i Malmö. Till min avhandling undersöker jag oljeskadeskyddsberedskapen i Sverige för oljeolyckor till havs som drabbar kusten. Informationen som samlas in kommer att ge användbar information om planering, insats, organisation och ledning av oljeskadeskyddet i Sverige. Eftersom du är involverad i oljeskadeskyddsberedskap, bjuder jag in dig till att delta i denna undersökning genom att svara på denna enkät. Enkäten tar ungefär en halvtimme att fylla i. Deltagande är naturligtvis frivilligt och du kan dra dig ur när som helst, men ditt deltagande är högst uppskattat.

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Insamlad information som inte är offentlig kommer att hållas konfidentiell och enbart resultatet i helhet kommer att göras tillgängligt, inte enstaka svar. Resultaten kommer att användas i min doktorsavhandling och göras tillgänglig genom vetenskapliga artiklar, konferenser och populärvetenskapliga artiklar.

Undersökningen har godkänts av den Vetenskapliga Etikkommittén på World Maritime University. Har du några problem eller frågor rörande undersökningen, kontakta då mig eller min handledare, professor Olof Lindén. Önskas ytterligare information, tveka då inte att kontakta mig.

Vänliga hälsningar,
Jonas Pålsson

0709-45 51 32
jp@wmu.se

Professor
Olof Lindén
040-35 63 30
ol@wmu.se

Godkänner du dessa villkor och skulle du vilja delta i undersökningen?
(X) Ja

( ) Nej

Datum och underskrift

2015-03-10

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Oljeskadeskyddsberedskap i Sverige

16/12-2014

Kära deltagare,
Mitt namn är Jonas Pålsson och jag doktorerar på World Maritime University i Malmö. Till min avhandling undersöker jag oljeskadeskyddsberedskapen i Sverige för oljeolyckor till havs som drabbar kusten. Informationen som samlas in kommer att ge användbar information om planering, insats, organisation och ledning av oljeskadeskyddet i Sverige. Eftersom du är involverad i oljeskadeskyddsberedskap, bjuder jag in dig till att delta i denna undersökning genom att svara på denna enkät. Enkäten tar ungefär en halvtimme att fylla i. Deltagande är naturligtvis frivilligt och du kan dra dig ur när som helst, men ditt deltagande är högst uppskattat.

Ingen kompensation utgår för att deltaga, men jag hoppas att mina resultat kommer till nytta för oljeskadeskyddsberedskapen i Sverige, genom att öka förstelsen och rekommendera förändringar.

Insamlad information som inte är offentlig kommer att hållas konfidentiell och enbart resultatet i helhet kommer att göras tillgängligt, inte enstaka svar. Resultaten kommer att användas i min doktorsavhandling och göras tillgänglig genom vetenskapliga artiklar, konferenser och populärvetenskapliga artiklar.

Undersökningen har godkänts av den Vetenskapliga Etikkommittén på World Maritime University. Har du några problem eller frågor rörande undersökningen, kontakta då mig eller min handledare, professor Olof Lindén. Önskas ytterligare information, tveka då inte att kontakta mig.

Vänliga hälsningar,
Jonas Pålsson

0709-45 51 32
jp@wmu.se

Professor
Olof Lindén
040-35 63 30
ol@wmu.se

Godkänner du dessa villkor och skulle du vilja delta i undersökningen?
(X) Ja
( ) Nej

Datum och underskrift

2015-03-11 [signature]

Appendix E – Management Results

Node table

List of all organisations mentioned in the survey responses.

Id	Label	English name	Swedish abbreviation	Swedish name	Type
A1	SCG	Swedish Coast Guard	KBV	Kustbevakningen	Agency
A2	MSB	Swedish Civil Contingencies Agency	MSB	Myndigheten för Samhällsskydd och Beredskap	Agency
A3	Depots	Oil Spill Equipment Depots	Oljeförråden	MSBs oljeskyddsdepåer	Agency
A4	SwAM	Swedish Agency for Marine and Water Management	HaV	Havs- och vattenmyndigheten	Agency
A5	OSAS	Oil Spill Advisory Service		Oljejouren	Agency
A6	EPA	Swedish Environmental Protection Agency	NVV	Naturvårdsverket	Agency
A7	SMA	Swedish Maritime Administration	SFV	Sjöfartsverket	Agency
A8	STA	Swedish Transport Agency	TS	Transportstyrelsen	Agency
A9	SAF	Swedish Armed Forces	FM	Försvarsmakten	Agency
A10	Police	Swedish Police	Polisen	Polismyndigheten	Agency
B1	CAB Blekinge	County Administrative Board of Blekinge		Länsstyrelsen Blekinge län	County Administrative Board
B2	CAB Gotland	County Administrative Board of Gotland		Länsstyrelsen Gotlands län	County Administrative Board
B3	CAB Gävleborg	County Administrative Board of Gävleborg		Länsstyrelsen Gävleborgs län	County Administrative Board
B4	CAB Halland	County Administrative Board of Halland		Länsstyrelsen Hallands län	County Administrative Board
B5	CAB Jönköping	County Administrative Board of Jönköping		Länsstyrelsen Jönköpings län	County Administrative Board
B6	CAB Kalmar	County Administrative Board of Kalmar		Länsstyrelsen Kalmar län	County Administrative Board
B7	CAB Norrbotten	County Administrative Board of Norrbotten		Länsstyrelsen Norrbottens län	County Administrative Board
B8	CAB Skåne	County Administrative Board of Skåne		Länsstyrelsen Skånes län	County Administrative Board
B9	CAB	County		Länsstyrelsen Stockholms län	County

	Stockholm	Administrative Board of Stockholm			Administrative Board
B10	CAB Södermanland	County Administrative Board of Södermanland		Länsstyrelsen Södermanlands län	County Administrative Board
B11	CAB Uppsala	County Administrative Board of Uppsala		Länsstyrelen Uppsala län	County Administrative Board
B12	CAB Värmland	County Administrative Board of Värmland		Länsstyrelsen Värmlands län	County Administrative Board
B13	CAB Västerbotten	County Administrative Board of Västerbotten		Länsstyrelsen Västerbottens län	County Administrative Board
B14	CAB Västernorrland	County Administrative Board of Västernorrland		Länsstyrelsen Västernorrlands län	County Administrative Board
B15	CAB Västmanland	County Administrative Board of Västmanland		Länsstyrelsen Västmanlands län	County Administrative Board
B16	CAB Västra Götaland	County Administrative Board of Västra Götaland		Länsstyrelsen Västra Götalands län	County Administrative Board
B17	CAB Örebro	County Administrative Board of Örebro		Länsstyrelsen Örebros län	County Administrative Board
B18	CAB Östergötland	County Administrative Board of Östergötland		Länsstyrelsen Östergötlands län	County Administrative Board
C1	Attunda	Attunda Fire Brigade		Brandkåren Attunda (Knivsta, Järfälla, Sigtuna, Sollentuna, Upplands-Bro och Upplands Väsby)	Municipality
C2	Bohuslän	Mitt Bohuslän Rescue Service Association		Räddningstjänstförbundet Mitt Bohuslän (Lysekil, Munkedal och Uddevalla)	Municipality
C3	BORF	Bohus Fire & Rescue Union	BORF	Bohus Räddningstjänstförbund (Ale och Kungälv)	Municipality
C4	Bromölla	Bromölla Rescue Service		Räddningstjänsten Bromölla	Municipality
C5	BRT	Bergslagen Rescue Service	BRT	Bergslagens räddningstjänst (Kristinehamn, Karlskoga, Filipstad, Degerfors, Hällefors och Storfors)	Municipality
C6	Båstad	Båstad municipality		Båstads kommun	Municipality
C7	Enköping-Håbo	Enköping-Håbo Rescue Service		Räddningstjänsten Enköping-Håbo (Enköping och Håbo)	Municipality

C8	Eskilstuna	Eskilstuna Rescue Service		Räddningstjänsten Eskilstuna	Municipality
C9	Gotland	Region Gotland		Region Gotland	Municipality
C10	Gästrike	Gästrike Rescue Service		Gästrike Räddningstjänst (Gävle, Sandviken, Ockelbo, Hofors och Älvkarleby)	Municipality
C11	Habo	Habo Rescue Service		Räddningstjänsten Habo kommun	Municipality
C12	Halmstad	Halmstad Rescue Service		Räddningstjänsten Halmstad	Municipality
C13	Haparanda	Haparanda Rescue Service		Räddningstjänsten Haparanda	Municipality
C14	Höga Kusten	Höga Kusten-Ådalen Rescue Service		Räddningstjänsten Höga Kusten - Ådalen (Härnösand, Kramfors och Sollefteå)	Municipality
C15	Höganäs	Höganäs Rescue Service		Räddningstjänsten Höganäs	Municipality
C16	Jönköping	Jönköping Rescue Service		Räddningstjänsten Jönköping	Municipality
C17	Kalix	Kalix Rescue Service		Räddningstjänsten Kalix	Municipality
C18	Kalmar	Kalmar Rescue Service		Räddningstjänsten Kalmar	Municipality
C19	Karlstad	Karlstad Region Rescue Service		Räddningstjänsten Karlstadsregionen (Forshaga, Grums, Hammarö, Karlstad, Kil och Munkfors)	Municipality
C20	Kristianstad	Kristianstad municipality		Kristianstads kommun	Municipality
C21	Laholm	Laholm municipality		Laholms kommun	Municipality
C22	Landskrona	Landskrona Rescue Service		Räddningstjänsten Landskrona	Municipality
C23	Lomma	Lomma municipality		Lommas kommun	Municipality
C24	Luleå	Luleå Rescue Service		Luleå kommun, räddningstjänsten	Municipality
C25	MBR	Mälardalen Fire and Rescue Association	MBR	Mälardalens Brand- och Räddningsförbund (Västerås, Hallstahammar och Surahammar)	Municipality
C26	Medelpad	Medelpad Rescue Service		Medelpads Räddningstjänstförbund (Timrå, Sundsvall och Ånge)	Municipality
C27	Motala	Motala-Vadstena Rescue Service		Räddningstjänsten Motala-Vadstena	Municipality
C28	Mönsterås	Mönsterås municipality		Mönsterås kommun	Municipality
C29	Nerike	Nerike Fire Brigade		Nerikes Brandkår (Örebro, Kumla, Hallsberg, Lekeberg, Laxå, Askersund,	Municipality

				Lindesberg och Nora)	
C30	Nordmaling	Nordmaling municipality		Nordmalings kommun	Municipality
C31	Norrhälsinge	Norrhälsinge Rescue Service		Norrhälsinge Räddningstjänst (Hudiksvall och Nordanstig)	Municipality
C32	Norrtälje	Norrtälje municipality		Norrtäljes kommun	Municipality
C33	NÄRF	Northern Älvsborg Rescue Service Association	NÄRF	Norra Älvsborgs Räddningstjänstförbund (Färgelanda, Mellerud, Trollhättan och Vänersborg)	Municipality
C34	Orust	Orust Rescue Service		Orust Räddningstjänst	Municipality
C35	Oskarshamn	Oskarshamn Rescue Service		Räddningstjänsten Oskarshamns kommun	Municipality
C36	Piteå	Piteå municipality		Piteås kommun	Municipality
C37	RFET	Emmaboda-Torsås Rescue Service Association	RFET	Räddningstjänstförbundet Emmaboda-Torsås (Emmaboda och Torsås)	Municipality
C38	RSG	Greater Gothenburg Rescue Service	RSG	Räddningstjänsten Storgöteborg (Göteborg, Mölndal, Kungsbacka, Härryda, Partille och Lerum)	Municipality
C39	RSNV	Northwestern Skåne Rescue Service	RSNV	Räddningstjänsten Skåne Nordväst (Helsingborg, Ängelholm och Örkelljunga)	Municipality
C40	RSYD	Rescue Service South	RSYD	Räddningstjänsten Syd (Burlöv, Eslöv, Kävlinge, Lund och Malmö)	Municipality
C41	RTÖG	Eastern Götaland Rescue Service	RTÖG	Räddningstjänsten Östra Götaland (Linköping, Norrköping, Söderköping, Valdemarsvik och Åtvidaberg)	Municipality
C42	RVS	Rescue Service Western Skaraborg	RVS	Räddningstjänsten Västra Skaraborg (Lidköping, Vara, Grästorp och Essunga)	Municipality
C43	RVÄST	Rescue Service West	RVÄST	Räddningstjänsten Väst (Varberg och Falkenberg)	Municipality
C44	RÖS	Rescue Service Eastern Skaraborg	RÖS	Räddningstjänsten Östra Skaraborg (Mariestad, Töreboda, Karlsborg, Skövde, Gullspång, Hjo och Tibro)	Municipality
C45	SBFF	Södertörn Fire Prevention Association	SBFF	Södertörns brandförsvarsförbund (Botkyrka, Ekerö, Haninge, Huddinge, Nacka, Nykvarn, Nynäshamn, Salem, Södertälje och Tyresö)	Municipality
C46	Skara-Götene	Skara-Götene Rescue Service		Räddningstjänsten Skara-Götene (Skara och Götene)	Municipality
C47	Skellefteå	Skellefteå municipality		Skellefteås kommun	Municipality

C48	Sotenäs	Sotenäs municipality		Sotenäs kommun	Municipality
C49	SSBF	Greater Stockholm Fire Brigade	SSBF	Storstockholms brandförsvar (Danderyd, Lidingö, Solna, Stockholm, Sundbyberg, Täby, Vallentuna, Vaxholm, Värmdö och Österåker)	Municipality
C50	Stenungsund	Stenungsund Rescue Service		Räddningstjänsten Stenungsunds kommun	Municipality
C51	Strängnäs	Strängnäs Rescue Service		Räddningstjänsten Strängnäs kommun	Municipality
C52	Strömstad	Strömstad municipality		Strömstads kommun	Municipality
C53	Säffle	Säffle Rescue Service		Räddningstjänsten Säffle	Municipality
C54	Söderhamn	Söderhamn municipality		Söderhamns kommun	Municipality
C55	SÖRF	Southeast Skåne's Fire and Rescue Service	SÖRF	Sydöstra Skånes Räddningstjänstförbund (Simrishamn, Skurup, Tomelilla och Ystad)	Municipality
C56	Sörmland	Sörmland Coast Rescue Service		Sörmlandskustens Räddningstjänst (Nyköping, Oxelösund, Trosa och Gnesta)	Municipality
C57	Tanum	Tanum Rescue Service		Räddningstjänsten Tanumskommun	Municipality
C58	Tjörn	Tjörn municipality		Tjörns kommun	Municipality
C59	Trelleborg	Trelleborg Rescue Service		Räddningstjänsten Trelleborg (Trelleborg och Vellinge)	Municipality
C60	Umeå	Umeå Rescue Service		Räddningstjänsten Umeå (Robertsfors och Umeå)	Municipality
C61	Uppsala	Uppsala Rescue Service		Uppsala brandförsvar (Tierp, Uppsala och Östhammar)	Municipality
C62	VMKFB	Western Mälardalen Municipal Association	VMKFB	Västra Mälardalens Kommunalförbund (Arboga, Kungsör och Köping)	Municipality
C63	Västervik	Västervik Rescue Service		Räddningstjänsten Västervik	Municipality
C64	Västra Blekinge	Western Blekinge Rescue Service		Räddningstjänsten Västra Blekinge (Karlshamn, Olofström, Sölvesborg)	Municipality
C65	Åmål	Åmål Rescue Service		Räddningstjänsten Åmål	Municipality
C66	Öckerö	Öckerö municipality		Öckerö kommun	Municipality
C67	Ödeshög	Ödeshög Rescue Service		Räddningstjänsten Ödeshög	Municipality

C68	Öland	Öland Rescue Service		Räddningstjänsten Öland (Mörbylånga och Borgholm)	Municipality
C69	Örnsköldsvik	Örnsköldsvik municipality		Örnsköldsviks kommun	Municipality
C70	Östra Blekinge	Eastern Blekinge Rescue Service		Räddningstjänsten Östra Blekinge (Karlskrona och Ronneby)	Municipality
D1	FRG	Voluntary Resource Group	FRG	Frivilliga Resursgruppen	Volunteer
D2	Hv	Home Guard – National Security Forces	Hv	Hemvärnet – Nationella skyddsstyrkorna	Volunteer
D3	KFV	Swedish Wildlife Rehabilitators Association	KFV	Katastrofhjälp Fåglar och Vilt	Volunteer
D4	SBS	Swedish Blue Star Voluntary Club		Blå Stjärnan	Volunteer
D5	SCF	Swedish Civil Defence League	CFF	Civilförsvarsförbundet	Volunteer
D6	SSRS	Swedish Sea Rescue Society	SSRS	Sjöräddningssällskapet	Volunteer
D7	SVK	National Association of Naval Volunteer Corps	SVK	Sjövärnskåren	Volunteer
E1	Almer Oil	Almer Oil & Chemical Storage		Almer Oil & Chemical Storage	Industry
E2	Arizona Chemicals	Arizona Chemicals		Arizona Chemicals	Industry
E3	Billeröd	Billeröd Gruvön Factory		Billeröd Gruvöns Bruk Grums	Industry
E4	Clean-up companies	Clean-up companies		Saneringsföretag	Industry
E5	Energy companies	Energy companies		Energibolag	Industry
E6	Entropi	Entropi		Entropi Sanerings	Industry
E7	Freight companies	Freight companies		Transportörer	Industry
E8	Holmen	Holmen		Holmen	Industry
E9	Innovators	Innovators		Innovatörer	Industry
E10	NBA	NBA Energy and Environmental Development	NBA	NBA Energi & Miljöutveckling	Industry
E11	Nynas	Nynas AB		Nynas AB	Industry
E12	Oil companies	Oil companies Norrköping		Oljehamnsbolagen i Norrköping	Industry
E13	Paper mills	Paper mills		Pappersbruk längs länets kust	Industry
E14	Port of Gothenburg	Port of Gothenburg		Göteborgs hamn	Industry
E15	Port of Luleå	Port of Luleå		Luleå hamn	Industry
E16	Port of Oxelösund	Port of Oxelösund		Oxelösunds hamn	Industry
E17	Port of Uddevalla	Port of Uddevalla		Uddevalla Hamnterminal	Industry
E18	Ports	Ports		Hamnar	Industry
E19	Preem	Preemraff Lysekil		Preemraff Lysekil	Industry

E20	Reception facilities	Reception facilities		Mottagningsanläggningar	Industry
E21	Recycling companies	Recycling companies		Återvinningsföretag	Industry
E22	Refineries	Refineries		Raffinaderier och petrokemisk industri	Industry
E23	Ringhals	Ringhals nuclear power plant		Ringhals kärnkraftverk	Industry
E24	SCA	SCA	SCA	Svenska Cellulosa Aktiebolaget	Industry
E25	Shipping companies	Shipping companies		Rederier	Industry
E26	Smurfit Kappa	Smurfit Kappa		Smurfit Kappa	Industry
E27	SRF	Swedish Shipowners' Association	SRF	Sveriges Redareförening	Industry
E28	SSAB	SSAB (formerly Swedish Steel AB)	SSAB	SSAB (fd Svenskt Stål AB)	Industry
E29	Stora Enso	Stora Enso		Stora Enso Skutskär	Industry
E30	SunPine	SunPine		SunPine	Industry
E31	Suppliers	Suppliers		Leverantörer	Industry
E32	Sweboat	Sweboat - the Swedish Marine Industries Federation		SweBoat - Båtbranschens Riksförbund	Industry
E33	Wibax	Wibax		Wibax	Industry
F1	Finland	Finnish authorities		Finska myndigheter med ansvar för oljeskadeskydd	Other
F2	IUA Østfold	IUA Østfold	IUA Østfold	Østfold Interkommunale Utvalg mot Akutt forurensning	Other
F3	Norway	Norwegian authorities		Norska myndigheter	Other
F4	SOS Alarm	SOS Alarm	SOS Alarm	SOS Alarm Göteborg	Other

Edge tables

Connections between organisations in a theoretical maximum scenario and the planning and response networks based on survey responses.

Theoretical maximum		Planning		Response	
Source	**Target**	**Source**	**Target**	**Source**	**Target**
A1	A2	A1	A2	A1	A10
A1	A3	A1	A3	A1	A2
A1	A4	A1	A4	A1	A3
A1	A5	A1	A5	A1	A4
A1	A6	A1	A6	A1	A5
A1	A7	A1	A7	A1	A6
A1	A8	A1	A9	A1	A7
A1	A9	A1	B1	A1	A8
A1	A10	A1	B10	A1	B1
A1	B1	A1	B11	A1	B10
A1	B2	A1	B12	A1	B11
A1	B3	A1	B13	A1	B12
A1	B4	A1	B14	A1	B13
A1	B5	A1	B15	A1	B14
A1	B6	A1	B16	A1	B15
A1	B7	A1	B17	A1	B16
A1	B8	A1	B18	A1	B17
A1	B9	A1	B2	A1	B18
A1	B10	A1	B3	A1	B2
A1	B11	A1	B4	A1	B3
A1	B12	A1	B5	A1	B4
A1	B13	A1	B6	A1	B5
A1	B14	A1	B7	A1	B6
A1	B15	A1	B8	A1	B7
A1	B16	A1	B9	A1	B8
A1	B17	A1	C1	A1	B9
A1	B18	A1	C10	A1	C1
A1	C1	A1	C11	A1	C10
A1	C2	A1	C12	A1	C11
A1	C3	A1	C13	A1	C12
A1	C4	A1	C14	A1	C13
A1	C5	A1	C15	A1	C14
A1	C6	A1	C16	A1	C15
A1	C7	A1	C17	A1	C16
A1	C8	A1	C18	A1	C17
A1	C9	A1	C19	A1	C18
A1	C10	A1	C2	A1	C19
A1	C11	A1	C20	A1	C2
A1	C12	A1	C21	A1	C20
A1	C13	A1	C22	A1	C21
A1	C14	A1	C23	A1	C22
A1	C15	A1	C24	A1	C23
A1	C16	A1	C25	A1	C24
A1	C17	A1	C26	A1	C25
A1	C18	A1	C27	A1	C26
A1	C19	A1	C28	A1	C27
A1	C20	A1	C29	A1	C28
A1	C21	A1	C3	A1	C29
A1	C22	A1	C30	A1	C3
A1	C23	A1	C31	A1	C30
A1	C24	A1	C32	A1	C31
A1	C25	A1	C33	A1	C32
A1	C26	A1	C34	A1	C33
A1	C27	A1	C35	A1	C34
A1	C28	A1	C36	A1	C35
A1	C29	A1	C37	A1	C36
A1	C30	A1	C38	A1	C37

A1	C31	A1	C39	A1	C38
A1	C32	A1	C4	A1	C39
A1	C33	A1	C40	A1	C4
A1	C34	A1	C41	A1	C40
A1	C35	A1	C42	A1	C41
A1	C36	A1	C43	A1	C42
A1	C37	A1	C44	A1	C43
A1	C38	A1	C45	A1	C44
A1	C39	A1	C46	A1	C45
A1	C40	A1	C47	A1	C46
A1	C41	A1	C48	A1	C47
A1	C42	A1	C49	A1	C48
A1	C43	A1	C5	A1	C49
A1	C44	A1	C50	A1	C5
A1	C45	A1	C51	A1	C50
A1	C46	A1	C52	A1	C51
A1	C47	A1	C53	A1	C52
A1	C48	A1	C54	A1	C53
A1	C49	A1	C55	A1	C54
A1	C50	A1	C56	A1	C55
A1	C51	A1	C57	A1	C56
A1	C52	A1	C58	A1	C57
A1	C53	A1	C59	A1	C58
A1	C54	A1	C6	A1	C59
A1	C55	A1	C60	A1	C6
A1	C56	A1	C61	A1	C60
A1	C57	A1	C62	A1	C61
A1	C58	A1	C63	A1	C62
A1	C59	A1	C64	A1	C63
A1	C60	A1	C65	A1	C64
A1	C61	A1	C66	A1	C65
A1	C62	A1	C67	A1	C66
A1	C63	A1	C68	A1	C67
A1	C64	A1	C69	A1	C68
A1	C65	A1	C7	A1	C69
A1	C66	A1	C70	A1	C7
A1	C67	A1	C8	A1	C70
A1	C68	A1	C9	A1	C8
A1	C69	A1	D6	A1	C9
A1	C70	A1	E20	A1	D6
A2	A1	A1	E31	A2	A1
A2	A3	A1	E7	A2	A10
A2	A4	A2	A1	A2	A3
A2	A5	A2	A10	A2	A4
A2	A6	A2	A3	A2	A5
A2	A7	A2	A4	A2	A9
A2	A8	A2	A5	A2	B1
A2	A9	A2	A6	A2	B10
A2	A10	A2	A7	A2	B11
A2	B1	A2	A8	A2	B12
A2	B2	A2	A9	A2	B13
A2	B3	A2	B1	A2	B14
A2	B4	A2	B10	A2	B15
A2	B5	A2	B11	A2	B16
A2	B6	A2	B12	A2	B17
A2	B7	A2	B13	A2	B18
A2	B8	A2	B14	A2	B2
A2	B9	A2	B15	A2	B3
A2	B10	A2	B16	A2	B4
A2	B11	A2	B17	A2	B5
A2	B12	A2	B18	A2	B6
A2	B13	A2	B2	A2	B7
A2	B14	A2	B3	A2	B8
A2	B15	A2	B4	A2	B9
A2	B16	A2	B5	A2	C1
A2	B17	A2	B6	A2	C10
A2	B18	A2	B7	A2	C11
A2	C1	A2	B8	A2	C12
A2	C2	A2	B9	A2	C13

A2	C3	A2	C1	A2	C14
A2	C4	A2	C10	A2	C15
A2	C5	A2	C11	A2	C16
A2	C6	A2	C12	A2	C17
A2	C7	A2	C13	A2	C18
A2	C8	A2	C14	A2	C19
A2	C9	A2	C15	A2	C2
A2	C10	A2	C16	A2	C20
A2	C11	A2	C17	A2	C21
A2	C12	A2	C18	A2	C22
A2	C13	A2	C19	A2	C23
A2	C14	A2	C2	A2	C24
A2	C15	A2	C20	A2	C25
A2	C16	A2	C21	A2	C26
A2	C17	A2	C22	A2	C27
A2	C18	A2	C23	A2	C28
A2	C19	A2	C24	A2	C29
A2	C20	A2	C25	A2	C3
A2	C21	A2	C26	A2	C30
A2	C22	A2	C27	A2	C31
A2	C23	A2	C28	A2	C32
A2	C24	A2	C29	A2	C33
A2	C25	A2	C3	A2	C34
A2	C26	A2	C30	A2	C35
A2	C27	A2	C31	A2	C36
A2	C28	A2	C32	A2	C37
A2	C29	A2	C33	A2	C38
A2	C30	A2	C34	A2	C39
A2	C31	A2	C35	A2	C4
A2	C32	A2	C36	A2	C40
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C45	C7
C45	C49
C45	C51
C45	C56
C46	B16
C46	C42
C46	C44
C46	C53
C47	B13
C47	C36
C47	C60
C48	B16
C48	C2
C48	C57
C49	B9
C49	C1
C49	C32
C49	C45
C50	B16
C50	C2
C50	C3
C50	C34
C50	C58
C51	B10
C51	C1
C51	C7
C51	C8
C51	C25
C51	C45
C52	B16
C52	C57
C53	B12
C53	C19
C53	C42
C53	C44
C53	C46
C53	C65
C54	B3
C54	C10
C54	C31
C55	B8
C55	C20
C55	C59
C56	B10
C56	C41

C56	C45
C57	B16
C57	C48
C57	C52
C58	B16
C58	C3
C58	C34
C58	C50
C59	B8
C59	C40
C59	C55
C60	B13
C60	C30
C60	C47
C61	B11
C61	C32
C61	C10
C62	B15
C62	C8
C62	C25
C63	B6
C63	C35
C63	C41
C64	B1
C64	C4
C64	C70
C65	B16
C65	C33
C65	C42
C65	C53
C66	B16
C66	C38
C67	B18
C67	C11
C67	C16
C67	C27
C67	C44
C68	B6
C68	C9
C68	C18
C68	C28
C68	C35
C68	C37
C69	B14
C69	C14
C69	C30
C70	B1
C70	C37
C70	C64

Understanding

Opinions of the survey respondents on understanding the roles of the oil spill preparedness organisations.

Type	SCG	MSB	Depots	SwAM	OSAS	EPA	SMA	STA	SAF	Police	CAB	Municipalities	Volunteers	Industry	Others
Agency	1	1	1	1	1	−2	1	1	−2	−1	1	1	−1	−2	
Agency	2	−1	2	−2	−1	−2	−1	−1	−1	−2	1	1	−2	−2	2
Agency	−1	−1	−1	−1	−1	−1	1	1	0	1	−1	−1	−1	0	−1
Agency	2	−1	0	−1	0	1	−1	−1	−1	−1	−1	1	1	−1	
Agency	2	1	0	0	1	−1	1	1	0	0	2	1	1	−1	0
Agency	1	1	−1	−1	−1	0	0	−1	0	0	−1	1	0	0	
Agency	0	−1	−1	−1	−1	−2	−1	−1	0	0	−1	−1	0	0	
CAB	2	2	1	0	0	0	0	0	1	1	2	2	0	1	
CAB	2	1	2	0	1	0	0	0	1	1	1	2	1	1	0
CAB	0	0	0									0			0
CAB	−1	−1	−1	−1	−1	−1	−1	−1	−1	−1	0	1	1	0	0
CAB	2	1	2	−1	1	−2	0	−1	2	2	2	2	1	−1	
CAB	2	1	2	0	2	0	0	0	1	0	2	2	2		
CAB	2	−1	2	−2	−2	−2	−2	−1	1	−1	−1	1	0	−1	0
CAB	2	1	2	−2	−2	−2	−1	−2	−1	−1	−1	1			−1
CAB	1	1	1	0	0	0	1	0	0	0	−1	1	1	0	0
CAB	1	2	0	0	1	−1	0	0	1	1	−1	1	−1	1	0
Municipality	1	1	1	0	1	−1	0	−1	0	0	−1	1	−1	−1	−1
Municipality	2	1	0	−1	−1	0	0	0	0	0	1	2	0	0	0
Municipality	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Municipality	2	2	2	−1	1	1	0	0	2	2	2	2	2	0	0
Municipality	−1	−1	−1	−2	−1	0	0	0	1	0	−1	−1	0	1	0
Municipality	1	−1	1	−1	1	−1	−2	−2	−2	−2	1	2	1	−1	2
Municipality	1	−1	−1	−1	−1	−1	−1	−1	−1	1	1	1	0	0	0
Municipality	−1	−1	−1	−1	−1	−1	−1	−1	0	0	−1	−1	−1	−1	0
Municipality	1	1	1	1	1	0	0	0	0	0	1	1	0	0	

Municip ality	2	2	2	1	1	0	0	0	0	0	2	0	0	0	0
Municip ality	1		1		1	0	1	1	1	1	1	1	0	0	
Municip ality	2	2	2	2	2	0	0	0	0	−2	2	2	−2	−2	−2
Municip ality	1	1	1	−1	1	−1	−1	−1	0	1	1	1	1	−1	
Municip ality	1	1	1	1	1	0	0	0	0	0	1	1	0	0	0
Municip ality	−1	1	1	−1	1	−1	−1	−1	0	0	−1	0	0	0	0
Municip ality	2	2	2	1	1	1	0	0	1	0		2	1	−1	
Municip ality	2	2	2	0	1	0	0	0	1	0	2	2	1	0	0
Municip ality	2	2	2	2	1	2	2	−1	−1	−1	1	−1	−2	0	0
Municip ality	1	1	1	1	1	1	0	0	0	0	1	1	1	0	
Municip ality	2	1	2	1	2	1	1	0	1	1	1	1	1	−1	0
Municip ality	1	1	1	0	0	1	1	1	0	0	1	1	0	0	0
Municip ality	2	−1	−1	−2	1	0	0	0	−1	0	−1	−1	−1	0	0
Municip ality	1	−1	−1	−1	1	−2	−2	−2	1	1	1	1	−1	0	0
Municip ality	1	−1	2	−1	1	−2	−1	−2	1	1	−1	2	2	0	
Municip ality	2	−1	1	−1	−1	1	1	−1	−1	−1	1	1	1	1	
Municip ality	2	1	1	1	1	0	0	0	0	0	0	−1	1	0	0
Municip ality	1	1	1	0	0	0	0	0	0	0	1	1	0	0	0
Municip ality	1	0	1	0	0	0	0	0	2	1	1	2	1	1	1
Municip ality	−1	−1	−1	−1	−1	−1	−1	−1	1	1	1	1	1	0	
Municip ality	2	1	1	−1	1	1	−1	−1	−1	−1	0	1	0	−1	0
Municip ality	1	1	2	1	1	1	1	−1	1	0	1	1	0	0	0
Municip ality	2	−1	−1	−2	−2	−2	1	−2	1	1	−1	2	0	1	0

Municipality	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
Municipality	2	2	2	−1	2	−1	0	0	0	0	2	1	0	1	0	
Municipality	1	1	1	1	1	0	1	1	0	1	1	1	0	1	0	
Municipality	2	−1	2	−2	1	−2	0	0	1	2	0	1	−2	0	0	
Municipality	2	2	2	1	2	0	1	0	0	1	2	2	1	1		
Municipality	2	−1	1	0	−1	0	0	−2	0	−1	1	2	1	0	0	
Municipality	1	1	1	−1	−1	−1	−1	−1	−1	−1	1	1	−1	−1	−1	
Municipality	2	2	2	1	2	1	1	0	1	−1	1	2	−1	−1	0	
Municipality	1	1	1	0	−1	−1	−1	−1	1	1	−1	1	1	0	0	
Municipality	1	1	1	0	0	0	0	0	0	0	1	1	1	0	0	
Municipality	1	0	0	0	0	0	0	0	0	0	1	1	0	1	0	
Municipality	2	2	2	0	2	0	0	0	0	0	2	2	0	0	0	
Municipality	1	0	0		0	1	1				1	2	0			
Municipality	−1	−1	−1	−1	−1	−1	−1	−1	−1	−1	−1	−1	2	2	2	
Municipality	1	1	1	−1	−1	0	−1	−1	1	0	1	1	0	−1	−1	
Municipality	1	1	1	1	1	1	1	1	1	0	1	1	0	0	0	
Municipality	2	2	2	0	1	1	2	1	1	0	2	2	0	1	0	
Average	1.17	0.52	0.82	−0.30	0.31	−0.31	−0.05	−0.39	0.19	0.06	0.56	0.97	0.17	−0.10	0.00	0.24

Planning value

Opinions of the survey respondents on the value for the oil spill preparedness organisations for oil spill contingency planning.

Type	SCG	MSB	Depots	SwAM	OSAS	EPA	SMA	STA	SAF	Police	CAB	Municipalities	Volunteers	Industry	Others
Agency	2	2	2	1	2	2	2	2	1	0	2	2	2	0	
Agency		2	−1	1	1	0	0	1	−1	−1	2	0	1	0	
Agency	2	2	2	2	2	2	2	2	−1	1	2	2	2	1	2
Agency	2	1		2			2	2	1	0	1	1	−1	0	
Agency	2	2	−1	1	1	0	1	1	−1	−1	1	1	1	0	−1
Agency	1	1	−2	1	0		1	2			1	1	1	1	
Agency	2	2	2	2	2	2	1	1	1	0	2	2	2	2	
CAB	2	2	1		0	0			0	0		2	1	−1	
CAB	2	0	1		1	1	1	0	−1	−1	2	2	−1	1	
CAB	2	1	1	1	1	0	0	1	1	1	0	2	1	−1	−1
CAB	2	2	2		2				−1	−2	2	2	2		
CAB	2	2	1	0	1	1	1	1	2	1	2	2	0	1	
CAB	2	2	0	1	−1	−1	0	1	−1	0	2	2	−2	−2	0
CAB	1	1	1	1	1	1	1		1	1	1	1			
CAB	2	2									2	2			
CAB	2	0	2			0			0	0		2	0		
CAB	1	−1	1	−2	−2	−1	1	−1	−2	−2	0	2	−1	−1	−1
Municipality	2	2	2	1	2	0	0	0	−1	−2	0	1	−2	−2	−2
Municipality	0	2	2	0	2	0	−1		1	1	1	2	2	−1	
Municipality	2	1	2	1	1				1	0	2	2	1	0	0
Municipality	2	0	1	−1	2	−1	−1	−1	1	−1	0	2	1	1	1
Municipality	0	0	0	−1	1	−1	0	−1	1	−1	1	0	1	−1	1
Municipality	2	2	1	2	2	1	1	1	0	0	2	2	0	2	
Municipality	2	2	2	1	2	0	0	0	0	0	2	2	1	1	
Municipality	2	2	2	2	2	2	2	2	2	1	2	2	1	1	
Municipality	1	2	1	1	0			0	0	0	2	2			

Municipality		2	2	2	2	0					2	2			
Municipality	1	2	0	0	0	0	0	0	0	0	1	1	0	0	0
Municipality	0	0	2	−1	1	−1	−1	−1	−1	−1	1	1	−1	−1	1
Municipality	2	2	2	2	2	2	2	0	0	−1	2	2	0	0	0
Municipality	1		0	1	1	0	0	−1	−1		1	1	−1	−1	
Municipality	2	2	2	2	2	0	1	1	0	0	2	2	0	1	0
Municipality	2	2	2	1	1	1	0	−1	−1	−1	2	2	0	2	
Municipality	1	0	2	1	1	1	1	1	0	0	2	2	0	2	
Municipality	2	1	2	2	2		0		2	−1	2	2	2		
Municipality	2	2	2	1	1	1	1	0	0	0	2	1	0	1	
Municipality	2	2	2		2	2	2	1	2	1	2	2	2	2	1
Municipality	2	1	2	0	1	1	1	0	1	−1	2	2	2	−2	
Municipality	2	2	2	2	2	2	2				2	2			
Municipality	2	2	2	−1	−1	1	1	1	1	1	−1	2	−1	−1	−1
Municipality	−1	1	2						−1	−2	2	2			
Municipality	1	1				1		1	1	1	1	1			
Municipality	−1	0	1	−1	−1	1	−1	−1	−1	−1	2	2	−1	0	2
Municipality	2	0	0	0	0	0	0	0	0	0	1	2	0	2	0
Municipality	1	0	2	−1	1	0	1	1	2	1	1	2	1	1	1
Municipality	1	1	2	2	2	1	1	1	1	0	2	2	0	−1	−1
Municipality	2	2	1	1	2	0	0	0	−1	−1	2	2	−1	1	2
Municipality	2	2	1	1	2	1	1	1	1	1	2	2	2	0	
Municipality	2	2	2	1	1	1	−1	−1	−1	−1	0	2	0	−1	−1

Municipality	2	2	1	2	0	2	0	1	0	−1	0	2	0	1	0
Municipality	2	2	2	1	0	1	2	0	0	0	2	2	1	0	0
Municipality	2	2	−2	2	−2	−2	−2	−2	−2	0	0	2	0	2	
Municipality	2	2	2						2	−1	2	2	1	1	1
Municipality	0	2	2	0	1	0	1	0	0	0	1	2	0	−1	−1
Municipality	−1	2	2	0	1	−1	−1	−1	−1	−1	2	1	−1	0	
Municipality	2	1	1	1	2	1	2	1	1	0	2		1	1	1
Municipality	2	1	2	0	−1	−1	−1	−1	−1	−1	2	2	−2	−2	−2
Municipality	2	2	2	2	2	2	2		−1	−1	2	2	1	−1	
Municipality	2	2	2	1	1	1	2	2	1	0	2	2	1	1	
Municipality	2	2	−1	−1	1	0	−1	−1	−1	−1	2		−1	0	0
Municipality	0	1	1	−1	−1	−1	−1	−1	−1	−1	1	0	−1	−1	−1
Municipality	2	2	1	0	0	0	0	1	0	0	1	2	0	−1	1
Municipality	1	2	2	−1	0	0		−1	−1	−1	2	2	0	−1	
Municipality	2	2	2								2	2			
Municipality	2	0	2	1	1	0	0	−1	−1	0	1	2	1	0	0
Municipality	1	0	0	−2	−2	−2	0	−2	−2	−2	1	1	−2	−2	−2
Municipality	2	0	2	0	1	0	0	0	1	−1	1	2	−1	0	0
Municipality	1	2	2	1	2	0	0	0	0	0	2	2	1	0	
Municipality	2	2	2	1	1	1					2				
Municipality	2	2	2	2	1	1	2	1	1	1	2		1	2	
Municipality	0	0	−1	−1	−1	−1	−1	−1	−1	−1	−1	−1	−1	−1	−1
Municipality	2	0	2	−1	1	−1	2	−1	1	2	2	2	0	−1	−1

Average	1.51	1.38	1.30	0.63	0.88	0.37	0.53	0.19	0.05	−0.29	1.46	1.69	0.25	0.07	−0.06	0.66

Response value

Opinions of the survey respondents on the value for the oil spill preparedness organisations for oil spill response.

Type	SCG	MSB	Depots	SwAM	OSAS	EPA	SMA	STA	SAF	Police	CAB	Municipalities	Volunteers	Industry	Others
Agency	1	2	2	0	2	2	−1	−1	2	0	2	2	2	0	
Agency	2	2	1	1	2	−1	0	1	0	−1	2	2	0	1	2
Agency	2	2	2	2	2	1	0	0		2	2	2	2	0	2
Agency	2	1					2	2	0	0	2	2	1		
Agency	2	2	0	2	2	1	2	1	0	0	2	2	1	0	0
Agency	1	1		1	1		0	2			0	0		1	
Agency	2	2	2	2	2	2	1	1	1	1	2	2	1	2	
CAB	2	1	1	0	1	1	1	1	−1	−1	2	2	−1	0	
CAB	2	2	2	2	2	2			1	1		2	1	1	
CAB	2	2	2		2		2					2			2
CAB	2	2	2		2		2		2	2	2	2		1	
CAB	2	2	−2	−2	1	−2	−1	0	1	1	2	2	−2	−2	1
CAB	1	−1	1	−1	−1	−2	1	−2	−2	−1	−1	2	1	−1	0
CAB	2	1	2	1	2	1	0	1	2	1	1	2	2	0	
CAB	2	2	2			0			0	0	1	2	0		
Municipality	2	2	2	2	2	0	2	2	0	0	1	2	0	1	
Municipality	2	2	2	2	2	1	1	1	2	−1	0	2	2	1	
Municipality	2	1	1	1	2	0	0	0	1	0	2		1		1
Municipality	2	1	2	1	2	0	1	0	0	0	1	2	1	2	0
Municipality	2	2	2	2	2	1	0	−1	1	−1	2	2	0	1	
Municipality	2	0	2	1	1	1	1	1	0	0	2	2	0	2	
Municipality	2	2	2	1	2	1	1	1	2	1	2	2	2	1	
Municipality	2	2	2	1	2	2	2	2	2	0	2	2	2	2	

Municipality	2	2	2	1	1	1	1	1	1	1	2	1	1	1	
Municipality	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2
Municipality	2	2	2	2	2						2	2			
Municipality	1	2	1	1	1	1	1	1	1	1	2	2	1	1	1
Municipality	2	2	2	2	2	−1	−1	−1	1	1	2	2	1	0	
Municipality	2	2	2								1	2			
Municipality	2	2	2		2						2	2	2		
Municipality	2	2	2	2	2	2	1	1	2	1	2	2	1	1	1
Municipality	0	0	2	0	1	0	−1	−1	−1	−1	2	2	1	0	2
Municipality	2	1	2	0	2	0	0	−1	−1	0	1	2	1	1	0
Municipality	2	2	2	2	2	2	2	0	2	0	2	2	1	0	0
Municipality	2	2	2		0	0	0	0	0	0	0	0	0	0	0
Municipality	2	2	2		2				2	−1	2	2			
Municipality	2	1	2	1	2	0	1	0	2	1	2	2	1	0	0
Municipality	1	1	1	1	1	1	0	0	0	1	1	1	0	0	
Municipality	0	1	2	−1	−1	−1	−1	−1	−1	−1	2	2	−1	−1	1
Municipality	1	0	1	0	1	0	0	0	2	1	1	2	1	1	1
Municipality	2	2	2	1	1	1	−1	−1	−1	−1	1	2	1		
Municipality	2	2				2		2	2	2	2	2			
Municipality	2	1	2	0	2	0	0	0	−1	−1	2	2	−2	1	0
Municipality	2	−1	2	1	1	−1	1	−1	−1	−1	1	2	−1	0	
Municipality	2	0	0	−1	−1	−1	−1	−1	−1	−1	−1	0	2	−1	−1
Municipality	2	0	0	0	1	0	1	0	0	0	1	2	1	2	0

Municipality	2	2	2	1	2						2	2	−1	2		
Municipality	2	2	2				1		1		2	2	1	1	1	
Municipality	2	1	2	1	2	1	0	0	2	0	1	2	0	0		
Municipality											2	2	2			
Municipality	2	0	2	1	2				2		2	2	1	−1		
Municipality	0	1	1	0	0	0	0	0	0	0	0	0	−1	−1	−1	
Municipality	2	1	2		1	1			2	0	2	2	2			
Municipality	2	0	2	0	1	0	0	0	0	1	0	1	1	0	0	
Municipality	2	2	2	1	1	1					2					
Municipality	2	2	2	1	1	0	1	0	0	0	2	2	0	0		
Municipality	2	0	1			−1	0	0	1	0	−1	2	0	−1		
Municipality	2	2	2	1	2	0	2	0	1	0	2	2	2	1	1	
Municipality	1	0	0	1	1	0	0				1	1				
Municipality	2	2	2	2	2	1	1	−1	1	0	2	2	1	0	1	
Municipality	2	1	2	0	2		1			0	2	1		0		
Municipality	2		2		2		2	2	2	2	2	2				
Average	1.79	1.35	1.64	0.88	1.45	0.46	0.60	0.28	0.71	0.22	1.47	1.78	0.73	0.47	0.65	0.96

Planning expectations

Expectations of the survey respondents on the oil spill preparedness organisations for oil spill contingency planning.

Type	SCG	MSB	Depots	SwAM	OSAS	EPA	SMA	STA	SAF	Police	CAB	Municipalities	Volunteers	Industry	Others
Agency	2	1	2	2	1	2	1	1	2	1	2	2	1	1	
Agency	0	0		2	2	0	0	0	1		1	1	0	0	
Agency	1	2	0	2	1	2	0	0		0	1	1	0	1	1
Agency	0	2		1			0	0	1		0	0	0	0	
Agency	1	2	0	1	0	1	0	1	0	0	1	1	0	1	0
Agency	0	0	0	0	0		0	0			0	0	0	1	
Agency	0	0	0	0	0	2	0	0	0	1	1	1	0	1	
CAB	1	2	1	2	0	2			0	0	1	0	0	0	
CAB	1	0					1	0	0	0	1	1		0	
CAB	2	1	0	0	0	0	0	1	0	0	0	2	0	0	0
CAB	0	0	0		0				0		1	0	0		
CAB	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
CAB	1	0	0	2	0	2	2	2	0	0	0	0	0	0	0
CAB	0	0	0									0			
CAB	0	0	0	0	0	0	0	0	−2	0	0	0	0	0	0
Municipality	2	2	2	0	2	0	2	2	0	0	2	0	0	1	
Municipality		0	0												
Municipality	0	0	0	0	0				0	0	0	0	0		
Municipality	2	1	1	1	2	1	1	0	2	0	1	1	0	1	0
Municipality	2	2	2	1	1	1	2	2	0	0	2	1	0	0	0
Municipality	2	1	0	0		0	1	0	0	0	2	−2	0	2	
Municipality	1	2	0	1	1	1	1	1	1	0	2	0	0	1	
Municipality	0	2	2	0	0	0	0	0	0	0	1	0	0	0	0
Municipality	0	1	2	0	1	0		1	0	0	1	0	0	0	
Municipality	2	1	0	0	1	2	2	2	2		0	0	2	2	

Municipality	1	1	1	1	0	0	0	0	0	0	1	0	0	1	0
Municipality	0	2	0	0	0	0	0	0	0	0	2	0	0	0	1
Municipality	0	0	0	0	0	0	0	0	0	0	1	0	0	1	0
Municipality	1	1	1	1	0	1	1				2	1		1	
Municipality	0	0	0	0	0	0	0	0	0	0	0	0		0	
Municipality	0	1	2	0	0	0	0	0	0	0	1	0	0	0	
Municipality	2	0	2	1	1	1	1	1	0	0	2	2	−2	2	
Municipality	0	1		0	0						1	0		1	
Municipality	2	2	2	1	1	1	1	1	0	0	2	1	0	1	
Municipality	0	0	0		0	0	0	0	0		0	0	0	0	
Municipality	0	0	1	0	0	0	0	0	0	0	0	0	0		
Municipality	2	2	1	2		1					2	2			
Municipality	0	0	0			0	0	0	0	0	2	0	0	0	
Municipality	1	0	0									2			
Municipality	0	0				0		0	0	0	0	0			
Municipality	0	1	1	0	0	1	0	−2	−2	−2	2	2	0	1	1
Municipality	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Municipality	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Municipality	0	1	1	1	1	1	1	1	1	1	1	1	0	0	0
Municipality	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Municipality	0	2	2	0	0	0	0	0	0	0	2	0	0	0	0
Municipality	1	1	1	0	0	0	0	0	0	0	0	0	0	0	0
Municipality	1	1	1	0	0	0	0	0	0	0	0	0	0	1	0

Municipality	0	0	0	0		0	0	0	0	0	0	0	0	0		
Municipality	1	2	1				2	2	0		2	1	0	0	0	
Municipality	1	2	2	1	1	1	1	0	2	0	1	2	0	0	0	
Municipality	1	0	0	1	1	0	0	0	0	0	1	0	0	0		
Municipality	1	0	1	0	1	1	0	0	0	0	1	2	0	1	0	
Municipality	0	1	0	1	1	0	0	0	0	0	1	2	0	1	0	
Municipality	1	1	2	0	0	0	0				1	2	0			
Municipality	0	1	1	2	2	0	0	0	0	0	0	1		1		
Municipality	1	1	0	1	1	1	0	0	0	0	1	0	1	1	0	
Municipality	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	
Municipality	1	1	0			0					0	0				
Municipality	1	1	1	0	0	0	0	0	0	0	2	0	0	0		
Municipality	0	1	0								0	0				
Municipality	1	0	1	0	0	0	0	0	1	0	1	2	1	0	0	
Municipality	2	0	0				0				1	0	0	1	0	
Municipality	2	−2	2	1	2	1	1	0	−2	−2	2	2	0	2	0	
Municipality	1	0	2	0	0	0	1	0	0	0	1	0	0	2		
Municipality	0	0	0	0	0	0	0				0					
Municipality	2	2	1	1	1	1	1	1	1	0	2	1	−2	1		
Municipality	1	1	1	1	1	1	0	0	0	0	1	1	0	0	0	
Municipality	1	1	1		1				1	1	1	1	0			
Average	0.74	0.75	0.69	0.55	0.49	0.50	0.41	0.31	0.16	0.00	0.91	0.55	0.02	0.55	0.10	0.45

Response expectations

Expectations of the survey respondents on the oil spill preparedness organisations for oil spill response.

Type	SCG	MSB	Depots	SwAM	OSAS	EPA	SMA	STA	SAF	Police	CAB	Municipalities	Volunteers	Industry	Others
Agency	2	1	0	2	1	2	0	0	0	0	2	2	1	1	
Agency	0	0	0	1	1	0	0	0	0	0	0	0	0	0	0
Agency	1	1	0	1	0	1	0	0		0	1	1	0	0	1
Agency	0	1		1			0	0	1		0	0	0		
Agency	1	1	0	1	0	1	1	1	0	0	0	0	0	1	0
Agency	0	0	0	0	0	0	0	0	0	0	0	0	0	1	
Agency	0	0	0	0	1	1	0	0	0	0	1	0	0	0	0
CAB	1	1	1				1		1	0	1	1		0	
CAB	1	1	1	1	1	1			0	0	1	1	0	0	
CAB	0	0	0	0	0				0	0		0	0		
CAB	0	1	0	0	0	0	0	0	1	0	0	1	0	1	
CAB	0	0	0	0	0	0	0	0	0	0	0	0	−2		0
CAB	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
CAB	2	1	1	0	1	1	0	0	0	0	0	0	0	0	
CAB	0	0	0			0	0			0	0	0	1	0	
Municipality	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
Municipality	2	2	2	1	0		1		2	0	1	2	0	1	
Municipality	2	2	1	0	1	1	1	1	0	0	2	0	0	0	0
Municipality	0	0	1	1	0	1	0	0	0	0	1	−1	0	1	
Municipality	0	0	1	0	0	0	0	0	0	0	0	1	0	0	
Municipality	2	0	2	1	1	1	1	1	1	1	2	2	2	2	
Municipality	1	2	1	2	1	1	1	1	1	0	2	1	1	2	
Municipality	2	2	2	2	2	2	2	2	0	0	2	0	0	0	
Municipality	2	2	2	1	1	1	1	1	0	0	2	1	0	0	
Munici	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0

pality															
Municipality	0	1	2	0	1	0	0	0	0	0	1	1			
Municipality	2	2	2	2	2	2	2	2	2		2	2	2	2	2
Municipality	1	1	1	0	0	0	0	0	0	0	1	0	0	1	0
Municipality	1	1	1	1	1	0	0	0	0	0	1	0	0	0	
Municipality	0	1	0								0	0			
Municipality	2	2	2		1	1	1				2	2			
Municipality	1	1	0			0					0	0			
Municipality	0	2	2	0	0	0	0	0	0	0	2	0	0	0	1
Municipality	1	1	0	0	1	0	0	0	0	0	1	1	1	1	0
Municipality	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Municipality	0	0	0	0	0	0	0	0	0	0	2	0	0	0	0
Municipality	0	0	0		0				0		0	0			
Municipality	0	1	0	1	0	0	0	0	0	0	0	0	0	0	0
Municipality	0	0	1	0	0	0	0	0	0	0	1	0	0	0	
Municipality	0	2	2	0	0	1	0	0	−1	−1	2	1	0	1	1
Municipality	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Municipality	0	1	1	0	0	0	0	0	0	0	0	0	0	0	0
Municipality	0	0				0		0	0	0	0	0			
Municipality	0	0	2	0	0	0	0	0	0	0	2	2		0	
Municipality	0	0	0	0	0		0			0	0	0		0	
Municipality	0	1	1				0	0	0	0	1	1	0	0	0
Municipality	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Munici	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0

pality																
Municipality	1	2	1				2	2	0		2	1	0	0	0	
Municipality	2	2	2	2	2	1	2	2	0	0	2	−1	0	2		
Municipality	2	2	2	2	0	2	2				2	2	0			
Municipality	0	1	0	0	0						1	0		2		
Municipality	0	1	1	0	0	0	0	0	0	0	0	0	0	0	0	
Municipality	0	0	0		0	0			0		0	0				
Municipality	1	1	1	0	0	0	0	0	1	1	0	2	1	0	0	
Municipality	0	0	0	0	0	0					0					
Municipality	1	1	1	0	0	0	1	0		0	0	0	0	1		
Municipality	0	0	0							0	0	0		0		
Municipality	1	1	1	0	1	0	0	0	2	1	2	0	1	2	0	
Municipality	2	2	1	1	0	1	1	0	0	0	2	1		2		
Municipality	0	0	0	1	0	0	0				2	0				
Municipality	2	1	2	1	1	1	0	0	1	0	2	1	0	2	0	
Municipality	1	0	1	0	0		0			0	0	0		0		
Municipality	2	2	2		2	2	2	2	2	2	2	2				
Average	0.66	0.80	0.76	0.50	0.42	0.48	0.41	0.32	0.27	0.08	0.84	0.48	0.17	0.52	0.19	0.46

Appendix F – Prevention Results

Financial statements of oil spill preparedness related posts from the Swedish national budgets 2000-2015 in million SEK.

Translation	Swedish name	2000	2001	2002	2003	2004	2005	2006
Environment	Allmän miljö- och naturvård	1,461	2,201	3,125	3,363	3,771	3,995	4,596
Marine	Havsmiljö/Åtgärder för havs- och vattenmiljö							
SEPA	Naturvårdsverket	278	303	311	314	323	327	334
SwAM	Havs- och vattenmyndigheten							
SCG	Kustbevakningen	440	474	507	548	622	642	692
MSB	Myndigheten för samhällsskydd och beredskap							
Swedish Rescue Services Agency	Statens räddningsverk: samhällets skydd mot olyckor	526	555	596	612	621	735	686
Crisis Preparedness Agency	Krisberedskapsmyndigheten				140	143	145	147
Crisis preparedness	Krisberedskap						1,747	1,779
Municipalities	Generellt statsbidrag till kommuner och landsting/Kommunalekonomisk utjämning	78,004	78,106	76,300	43,129	44,142	57,469	58,129

Translation	2007	2008	2009	2010	2011	2012	2013	2014	Prop 2015	Bill 2015
Environment	4,615	4,722	5,338	5,245	5,129	5,025	4,893	5,156	6,881	5,348
Marine				370	579	738	503	673	742	667
SEPA	339	339	337	349	375	368	370	377	414	378
SwAM					102	193	202	207	228	208
SCG	778	857	923	990	999	999	1,007	1,047	1,040	1,040
MSB			907	961	988	1,045	1,025	1,060	1,044	1,044
Swedish Rescue Services Agency	669	669								
Crisis Preparedness Agency	166	165								
Crisis preparedness	1,712	1,637	1,531	1,171	1,154	1,111	1,172	1,113	1,014	1,014
Municipalities	70,818	62,498	64,772	72,749	85,003	81,975	85,603	90,128	90,773	90,773

Appendix G – Planning Results

Sensitivity index development

The number of municipalities using different kinds of environmental sensitivity mapping systems in the 2011 and 2013 surveys is shown.

Question	Answer	2011	2013	2015	Combined
Is a sensitivity index used?	**Environmental Atlas**	40	49		58
	Own system	25	13		21
	No system	27	11		23
	No reply	34	53		24
	Total	**126**	**126**		**126**

Plan development

The number of municipalities having written or revised their oil spill contingency plan during various times in the 2011, 2013, and 2015 surveys, as well as the combined score using all three datasets.

Question	Answer	2011	2013	2015	Combined
When was the plan revised?	**0-5 years ago**	32	46	65	83
	>5 years ago	16	16	6	12
	No plan	46	16	25	25
	No reply	32	48	30	6
	Total	**126**	**126**	**126**	**126**

Organisational resources

Changes in budget and staff resources compared to if the organisation has an oil spill contingency plan or not.

	Budget				Staff resources			
	Municipalities		CABs		Municipalities		CABs	
	Plan	No plan	Plan	No plan	Plan	No plan	Plan	No plan
Decreased	1	1	0	0	2	1	1	0
No change	26	12	5	2	27	12	4	3
Increased	8	2	1	2	6	2	1	1
Total	**35**	**15**	**6**	**4**	**35**	**15**	**6**	**4**

External projects

Participation in external projects from municipality and CAB questionnaire responses and municipalities listed as partners in EU projects.

	Responses		Listed		CABs	
	Plan	No plan	Plan	No plan	Plan	No plan
Project	11	2	31	8	3	1
No project	24	13	52	29	3	3
Total	**35**	**15**	**83**	**37**	**6**	**4**

Appendix H – Response Results

Courses

Oil spill preparedness course participation between 2004 and 2015.

Course name	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	Total
Oil spill preparedness environmental impacts							33	27	47	11	32	**150**
Oil spill preparedness limitation and clean-up							20	19	27	12	21	**99**
Oil spill preparedness clean-up manager								10	24	28		**62**
Oil spill preparedness staff specialist								9		13		**22**
Oil spill preparedness land spills										52	21	**73**
Marine oil spill preparedness basics	8	14	15		14							**51**
Marine oil spill preparedness advanced	9	7		13	9							**38**
Marine oil spill preparedness command and cooperation				10	6							**16**
Total	**17**	**21**	**15**	**23**	**29**	**0**	**53**	**65**	**98**	**116**	**74**	**511**

Exercise development

The number of municipalities having exercised during various times in the 2011, 2013, and 2015 surveys, as well as the combined score using all three datasets.

Question	Answer	2011	2013	2015	Combined
When was the plan exercised?	**0-5 years ago**	29	37	56	72
	>5 years ago	9	3	0	3
	No exercise	56	41	35	45
	No reply	32	45	35	6
	Total	**126**	**126**	**126**	**126**

Evaluation framework

The evaluation model used to categorise the analysed evaluations.

Question	Response options						
What was the name of the event?	Name/s						
What year did the event take place?	Number						
What was the name of the organising organisation?	Name/s						
What were the names of the other participant organisations?	Name/s						
What kind of event was it?	Exercise seminar	Exercise workshop	Tabletop exercise	Drill exercise	Functional exercise	Full-scale exercise	Real spill
Did the event have concrete aims?	Yes	Partially	No				
How often is this exercise performed?	Unique	Annual	Biannual	Recurring			
Which organisations did the evaluators represent?	Name/s						
What type of evaluation is this?	Internal	External	Both				
What year was the evaluation written?	Number						
Did the evaluation have specific target groups?	Yes	Partially	No				
Which method did the evaluation use?	Name						
Did the evaluation have specific evaluation criteria?	Yes	Partially	No				
Did the evaluation have specific performance objectives?	Yes	Partially	No				
Where did the evaluation data come from? ***(Multiple answers possible)***	Evaluator notes	Documentation	Interviews	Questionnaire			
Does the evaluation refer to the contingency plan?	Yes	Partially	No				
Does the evaluation refer to earlier spills?	Yes	Partially	No				
Does the evaluation refer to earlier evaluations?	Yes	Partially	No				
Does the evaluation refer to response priorities?	Yes	Partially	No				
How many pages did the evaluation have?	Number						
How was the evaluation distributed? ***(Multiple answers possible)***	Email	Report	Seminar	Other			
To whom was the evaluation distributed?	Names	Unknown					
Did the evaluation have recommendations?	Yes	Partially	No				
Did the recommendations require a follow-up?	Yes	Partially	No				
Are there any previous oil spills?	Text						
Are there any previous oil spill exercises?	Text						
Comments	Text						

Evaluation database

The evaluations analysed according to the evaluation framework, divided between real spills and exercises.

Question	Real spills	
What was the name of the event?	**Fu Shan Hai**	**Tjörn (*Golden Trader*)**
What year did the event take place?	2003	2011
What was the name of the organising organisation?	Southeast Skåne's Fire and Rescue Service	Municipality of Tjörn
What were the names of the other participant organisations?	Municipalities of Ystad, Trelleborg and Simrishamn, Swedish Armed Forces, County Administrative Board of Skåne, Swedish Rescue Services Agency (SRSA, now the Swedish Civil Contingencies Agency, MSB), Swedish Coast Guard, Police, IVL, Swedish Wildlife Rehabilitators (KFV), KBM	County Administrative Board of Västra Götaland, MSB, SwAM, Swedish Coast Guard, Sweco, Swedish Armed Forces, Swedish Sea Rescue Society, Entropi, Greater Gothenburg Rescue Service and Stenungsund Rescue Service
What kind of event was it?	Real spill	Real spill
Did the event have concrete aims?	Yes	Yes
How often is this exercise performed?	Unique	Unique
Which organisations did the evaluators represent?	Southeast Skåne's Fire and Rescue Service	MSB, SwAM
What type of evaluation is this?	Internal	External
What year was the evaluation written?	2003	2014
Did the evaluation have specific target groups?	No	Yes
Which method did the evaluation use?	No specific method	MSB model
Did the evaluation have specific evaluation criteria?	Yes	Yes
Did the evaluation have specific performance objectives?	No	Yes
Where did the evaluation data come from? *(Multiple answers possible)*	Evaluator notes, documentation	Documentation, interviews
Does the evaluation refer to the contingency plan?	No	Yes
Does the evaluation refer to earlier spills?	No	Yes
Does the evaluation refer to earlier evaluations?	No	Yes
Does the evaluation refer to response priorities?	Yes	Yes
How many pages did the evaluation have?	77	131
How was the evaluation distributed? *(Multiple answers possible)*	Report	Report, seminars
Did the evaluation have a dissemination plan?	No	Yes
Did the evaluation have recommendations?	Yes	Yes
Did the recommendations require a follow-up?	No	No
Are there any previous oil spills?	*Jawachta*, Trelleborg 1974, 1,000 tonnes spilled.	*Tolmiros*, Västra Götaland north of Gothenburg 1987, 200 tonnes spilled.
Are there any previous oil spill exercises?	No previous exercises found.	No previous exercises found.
Comments	No contingency plan existed. Report available online from MSB (w/o appendices).	Performance objectives are related to the organisations' responsibilities. Report available online from MSB.

Reference		Ljungkvist, E. (2003). Oljesanering på Österlenkusten efter “Fu Shan Hai:s” haveri 2003 (1st ed., pp. 1–40). Ystad: Sydöstra Skånes Räddningstjänstförbund.	MSB, Hav. (2014). Oljepåslaget på Tjörn 2011 (No. MSB687) (pp. 1–131). MSB.

Question	**Exercises**								
What was the name of the event?	**Matteus**	**Skåne Nordväst**	**Blekinge**	**Gotland**	**Olivia**	**BOILEX**	**FSHex13**	**Hedvig**	**Barbro**
What year did the event take place?	2010	2010	2011	2011	2011	2011	2013	2014	2014
What was the name of the organising organisation?	Greater Gothenburg Rescue Service, Öckerö Rescue Service, Swedish Coast Guard (SCG)	Skåne Nordväst	Municipalities of Ronneby and Karlskrona, Southeast Skåne’s Fire and Rescue Service, Western Blekinge Rescue Service	Region Gotland, Southeast Skåne’s Fire and Rescue Service, Swedish Civil Contingencies Agency (MSB)	Greater Stockholm Fire Brigade (SSBF)	Swedish Civil Contingencies Agency (MSB) and Swedish Coast Guard (SCG)	Southeast Skåne’s Fire and Rescue Service	Skåne Nordväst	County Administrative Board of Halland

What were the names of the other participant organisations?	Municipality of Gothenburg and Öckerö, County Administrative Board of Västra Götaland, European Maritime Safety Agency (EMSA), Norwegian Coastal Administration (NCA), Swedish Civil Contingencies Agency (MSB), Southeast Skåne's Fire and Rescue Service, Sweco, Swedish Wildlife Rehabilitators (KFV), Swedish Sea Rescue Society (SSRS), Defence Command Denmark (SOK)	Municipalities of Ängelholm, Höganäs, and Helsingborg, Swedish Coast Guard (SCG), IVL, County Administrative Board of Skåne, Port of Helsingborg, Police, Southeast Skåne's Fire and Rescue Service.	Swedish Sea Rescue Society (SSRS), Swedish Wildlife Rehabilitators (KFV), Swedish Coast Guard (SCG), County Administrative Board of Blekinge, municipalities of Karlshamn and Sölvesborg, port of Karlshamn, Eastern Blekinge Rescue Service, Swedish Civil Contingencies Agency (MSB), Miljöförbundet Blekinge Väst	Swedish Coast Guard (SCG), Greater Stockholm Fire Brigade (SSBF), Gotland Rescue Service, Swedish Wildlife Rehabilitators (KFV)	Municipalities of Tyresö, Värmdö, Nynäshamn and Haninge, Swedish Civil Contingencies Agency (MSB), County Administrative Board of Stockholm, IVL, Swedish Coast Guard (SCG), Södertörn Fire Prevention covenant (SBFF), SOS Alarm, SL, Stockholm County Council, Swedish Police, TV, Traffic Stockholm, Swedish Wildlife Rehabilitators (KFV), Swedish Civil Defence League (FRG)	Centre for Economic Development, Transport and the Environment in Southeast Finland, Committee for nature use, Environmental Protection and Ecological Safety, County Administrative Board of Stockholm, European Maritime Safety Agency (EMSA), Estonian Academy of Security Sciences, Estonian Environmental Inspectorate, Estonian Fund for Nature (ELF), Estonian Maritime Academy, Estonian Rescue Board, Finnish Environment Institute (SYKE), Finnish ministry of the Environment, Greater	Swedish Coast Guard (SCG), Swedish Maritime Administration (SMA), Danish Emergency Management Agency (DEMA), Defence Command Denmark (SOK), Danish Police	Municipalities of Båstad, Ängelholm, Höganäs, Helsingborg, Klippan/Åstorp, and Landskrona	Municipalities of Kungsbacka, Varberg, Falkenberg, Halmstad, Laholm, and Hylte, Region Halland, Police Swedish Armed Forces, Regional Resource Group (RRG), Sweco, Swedish Coast Guard (SCG)

	Stockholm Fire Brigade (SSBF), HAAGA-HELIA University of Applied Sciences, Haninge municipality, Itä-Uusimaa regional rescue services, Jõelähtme municipality, Swedish Wildlife Rehabilitators (KFV), Kotka Maritime Research Centre, Ministry of the Environment of Estonia, Nacka municipality, Nacka Värmdö räddningssällskap, Nynäshamn municipality, Port of Stockholm, Swedish Meteorological and Hydrological Institute (SMHI), Southwest Finland emergency services, State Unitary Enterpris	

						e, St Petersburg emergency service (SUE ”PILARN”), Sweco, Swedish Civil Defence League (FRG), Sweden, Swedish Sea Rescue Society (SSRS), Swedish Blue Star, Södertörn Fire and Rescue Service (SBFF), Swedish Environment and Health Protection Union, Tyresö municipality, Estonian Volunteer Reserve Rescue Team, West-Estonia Voluntary Reserve Rescue Team, WWF Finland, Västra Nylands rescue service, Åland rescue service			
What kind of event was it?	Full-scale exercise	Functional exercise	Functional exercise	Functional exercise	Functional exercise	Full-scale exercise	Functional exercise	Functional exercise	Functional exercise
Did the event have concrete	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes

aims?									
How often is this exercise performed?	Annually	Unique	Unique	Unique	Unique	Unique	Unique	Biannually	Unique
Which organisations did the evaluators represent?	Swedish Coast Guard (SCG) and Greater Gothenburg Rescue Service, municipality of Skien, Södra Älvsborg Fire & Rescue Services	Skåne Nordväst	Municipality of Sölvesborg, Eastern Blekinge Rescue Service, Helsingborg Rescue Service, US Coast Guard	Region Gotland	County Administrative Board of Stockholm	MSB, Committee for nature use, environmental protection and ecological safety, St Petersburg, SUE "Pilarn", Estonian Rescue Board, Itä-Uusimaa regional rescue services, SCG, KFV, County Administrative Board of Stockholm, US Coast Guard (USCG), IVL	SMA, SCG, BRIDGE, Crisis Training, SAAB Technology, Stockholm University, Danish Police, NJ Resources	Skåne Nordväst	County Administrative Board of Halland, municipalities of Kungsbacka, Varberg, Falkenberg, Halmstad, Laholm, and Hylte, Swedish Civil Contingencies Agency (MSB)
What type of evaluation is this?	Both	Internal	Both	Internal	Internal	Both	Both	Internal	Both
What year was the evaluation written?	2010	2011	2011	2011	2011	2012	2013	2014	2015
Did the evaluation have specific target groups?	No	No	No	No	No	No	Yes	No	Yes
Which method did the evaluation use?	MTO	No specific method	No specific method	No specific method	No specific method	Accimap, Deviation investigation, MTO, HSEEP EEG	OSHBIP and AKKA	No specific method	Target based
Did the evaluation have	Yes	No	Yes	Yes	Yes	Yes	Yes	No	Yes

specific evaluation criteria?									
Did the evaluation have specific performance objectives?	No	No	No	No	No	No	Yes	No	No
Where did the evaluation data come from? *(Multiple answers possible)*	Evaluator notes, documentation	Evaluator notes, documentation	Evaluator notes, documentation, questionnaires	Evaluator notes, documentation, questionnaires	Evaluator notes	Evaluator notes, documentation	Evaluator notes, documentation, questionnaires	Evaluator notes, documentation	Evaluator notes, documentation, questionnaires
Does the evaluation refer to the contingency plan?	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Does the evaluation refer to earlier spills?	No	No	No	No	No	No	Yes	No	No
Does the evaluation refer to earlier evaluations?	No	No	No	No	No	No	Yes	Yes	No
Does the evaluation refer to response priorities?	Yes	Yes	Yes	No	Yes	Yes	Yes	Yes	No
How many pages did the evaluation have?	28	19	19	2	14	44	28	43	35
How was the evaluation distributed? *(Multiple answers possible)*	Report, seminar	Report	Report	Report	Report	Report, seminars	Report, seminars	Report	Report, seminar
Did the evaluation have a dissemination plan?	No	No	No	No	No	Yes	Yes	No	Yes
Did the evaluation have recomme	No	Yes	No	No	Yes	Yes	Yes	Yes	Yes

ndations?									
Did the recommendations require a follow-up?	No	No	No	No	No	No	Yes	No	Yes
Are there any previous oil spills?	*Unknown*, Halland and Västra Götaland counties 1992, 200 tonnes oil spilled. *Eva Oden*, Gothenburg 1980, 250 tonnes spilled.	*Hual Trooper*, the Sound 1995, 180 tonnes spilled. *Unknown*, Torekov 1988, 200 tonnes spilled. *Sivona*, the Sound 1982, 800 tonnes spilled. *Furenäs*, the Sound 1980, 200 tonnes spilled *Rio Iquazu*, the Sound 1975, 230 tonnes spilled. *Tärnsjö*, the Sound 1973, 300 tonnes spilled.	*Volgoneft 263,* Karlskrona 1990, 1,000 tonnes oil spilled.	*Sefir*, Öland 1981, 500 tonnes spilled.	*José Martin*, Dalarö 1981, 1,000 tonnes spilled. *Irini*, Nynäshamn 1970, 1,000 tonnes oil spilled.	*José Martin*, Dalarö 1981, 1,000 tonnes spilled. *Irini*, Nynäshamn 1970, 1,000 tonnes oil spilled.	*Fu Shan Hai*, Ystad 2003, 1,200 tonnes spilled.	*Hual Trooper*, the Sound 1995, 180 tonnes spilled. *Unknown*, Torekov 1988, 200 tonnes spilled. *Sivona*, the Sound 1982, 800 tonnes spilled. *Furenäs*, the Sound 1980, 200 tonnes spilled *Rio Iquazu*, the Sound 1975, 230 tonnes spilled. *Tärnsjö*, the Sound 1973, 300 tonnes spilled.	*Unknown*, Halland and Västra Götaland counties 1992, 200 tonnes oil spilled.
Are there any previous oil spill exercises?	Copenhagen Agreement annual exercises, last in Karlshamn 2009. does not usually	No previous exercises found.	No previous exercises found.	At least one previous Copenhagen agreement exercise.	No previous exercises found.	Previous Olivia exercise in 2011.	No previous exercises found.	Previous Skåne Nordväst exercise in 2010.	No previous exercises found.

	include shoreline response.								
Comments	Professional evaluators involved. The exercise development referred to the previous exercise.	Short evaluation focused on the lessons learned and not on methods.	Not a full evaluation done. Due to miscommunication, the evaluation is instead a summary of comments.	Short evaluation focused on the lessons learned and not on methods.	Preparation exercise for the larger BOILEX.	Many professional evaluators involved. Report available online from EnSaCo and MSB.	Many professional evaluators involved. Report available online from Oceanus.	Short evaluation focused on the lessons learned and not on methods.	
Reference	Ljungkvist, E. (2011). Utvärdering Oljeskyddsövning Matteus 21-22 september 2010 Göteborg (pp. 1–28). Göteborg: MSB, Kustbevakningen, Räddningstjänsten Storgöteborg.	Jönsson, C., & Svenbro, M. (2011). Oljeskyddsövning Skåne Nordväst 26 oktober 2010 (pp. 1–19). Ängelholm: Helsingborg & Ängelholm.	Haglund, U. (2011). Oljeskyddsövning Blekinge för Övningsledning och utvärderare (pp. 1–19). Karlskrona: Baltic Master II.	Region Gotland. (2011). Minutes Övning Baltic Master II (pp. 1–2). Visby: Region Gotland.	Sjödin, T. (2011). Övning Olivia (pp. 1–14). Länsstyrelsen i Stockholms län.	MSB. (2012). BOILEX 2011 Final exercise report (No. 2011-2836) (7 ed., pp. 1–44). Stockholm: MSB.	Ljungkvist, E., Munk, C., Mårtensson, J., Rasmussen, F. K., Bloch, J., & Bergman, P. (2013). Utvärdering av FSHex13 (pp. 1–28). Ystad: Oceanus.	Skåne Nordväst. (2014). Övning Hedvig - Övningsplanering i samverkan (pp. 1–12). Ängelholm: Skåne Nordväst.	Länsstyrelsen Hallands Län. (2015). Övning Barbro – Utvärderingsrapport - underlag vid utvärderingsseminarium (pp. 1–35). Halmstad: Länsstyrelsen Hallands Län.

External projects

Participation in external projects from municipality and CAB questionnaire responses and municipalities listed as partners in EU projects.

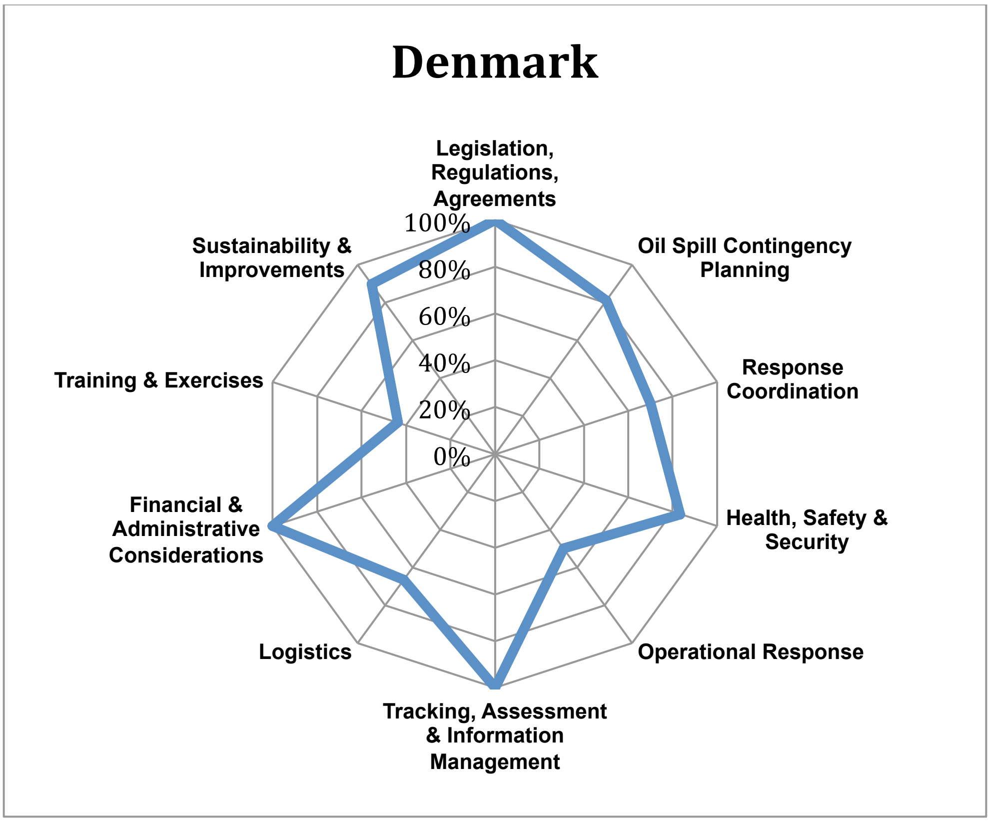
	Responses		Listed		CABs	
	Exercise	**No exercise**	**Exercise**	**No exercise**	**Exercise**	**No exercise**
Project	12	1	33	6	4	0
No project	23	13	39	42	5	1
Total	**35**	**14**	**72**	**48**	**9**	**1**

Appendix I – International Practice

Results

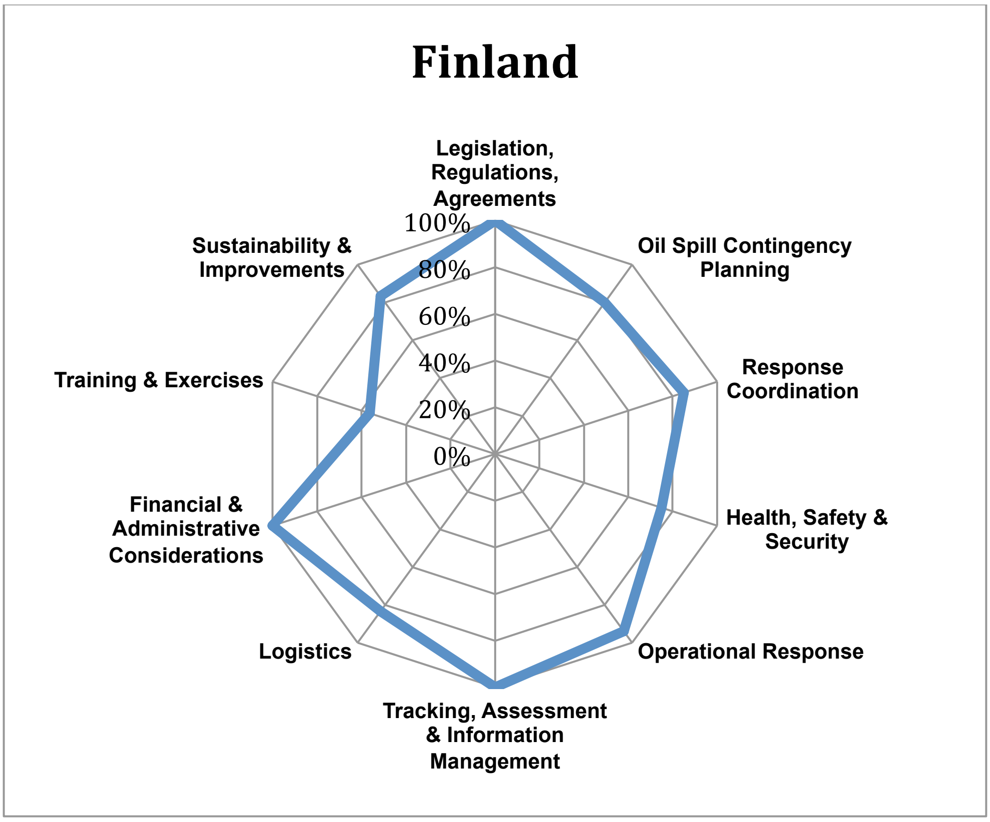
RETOS™ Global Performance Analysis Results Level A evaluation scores of the examined countries. A yellow field means that a critical indicator is missing or only partially completed.

Denmark RETOS™ evaluation scores



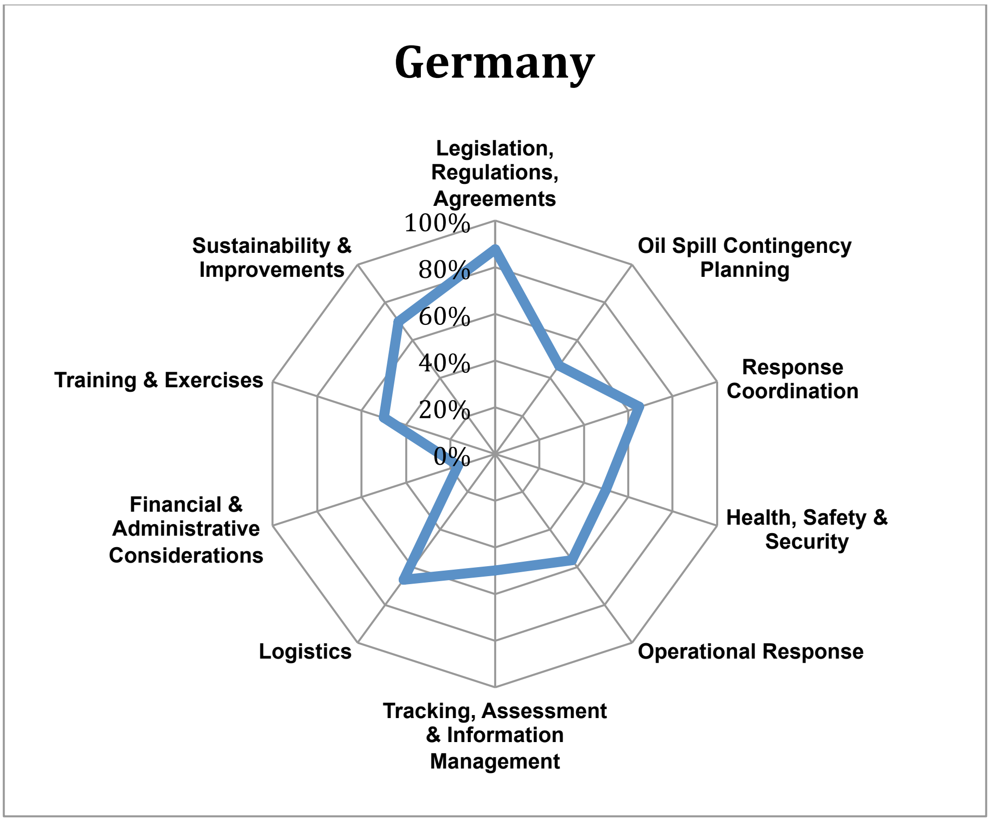
Category	**Value**
Legislation, Regulations, Agreements	100%
Oil Spill Contingency Planning	81%
Response Coordination	70%
Health, Safety & Security	83%
Operational Response	50%
Tracking, Assessment & Information Management	100%
Logistics	67%
Financial & Administrative Considerations	100%
Training & Exercises	44%
Sustainability & Improvements	90%
Total	**73%**
Institution Specific Criteria	*N/A*
#Completed / Number of questions:	40/ 66
Level A Overall Assessment: 73% (In Development)	

Finland RETOS™ evaluation scores



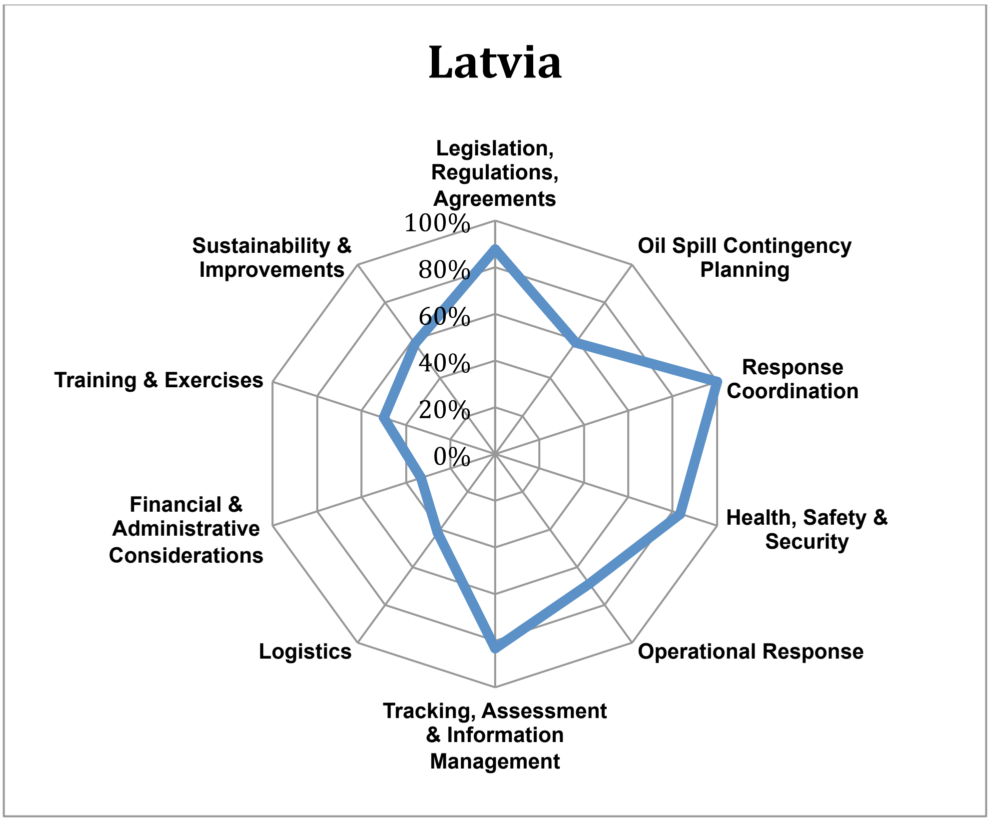
Category	**Value**
Legislation, Regulations, Agreements	100%
Oil Spill Contingency Planning	80%
Response Coordination	85%
Health, Safety & Security	75%
Operational Response	94%
Tracking, Assessment & Information Management	100%
Logistics	83%
Financial & Administrative Considerations	100%
Training & Exercises	56%
Sustainability & Improvements	83%
Total	**83%**
Institution Specific Criteria	*N/A*
#Completed / Number of questions:	45/ 65
Level A Overall Assessment: 83% (In Development)	

Germany RETOS™ evaluation scores



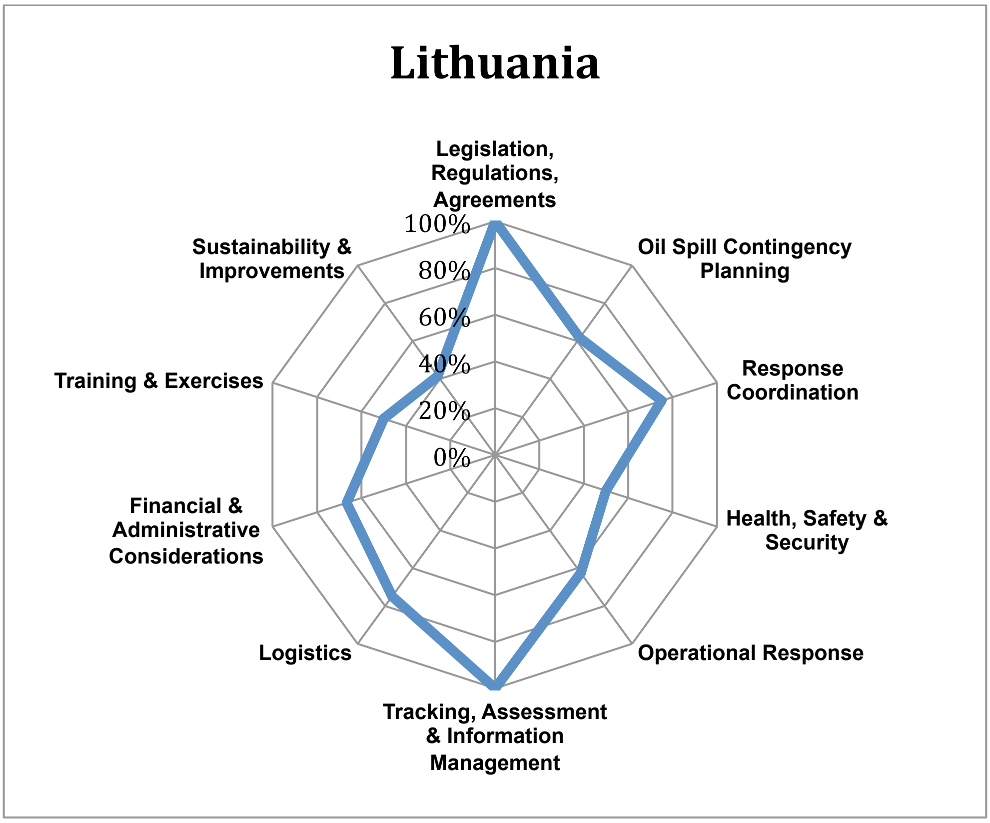
Category	**Value**
Legislation, Regulations, Agreements	88%
Oil Spill Contingency Planning	47%
Response Coordination	65%
Health, Safety & Security	50%
Operational Response	56%
Tracking, Assessment & Information Management	50%
Logistics	67%
Financial & Administrative Considerations	17%
Training & Exercises	50%
Sustainability & Improvements	70%
Total	**56%**
Institution Specific Criteria	*N/A*
#Completed / Number of questions:	18/ 57
Level A Overall Assessment: 56% (In Development)	

Latvia RETOS™ evaluation scores



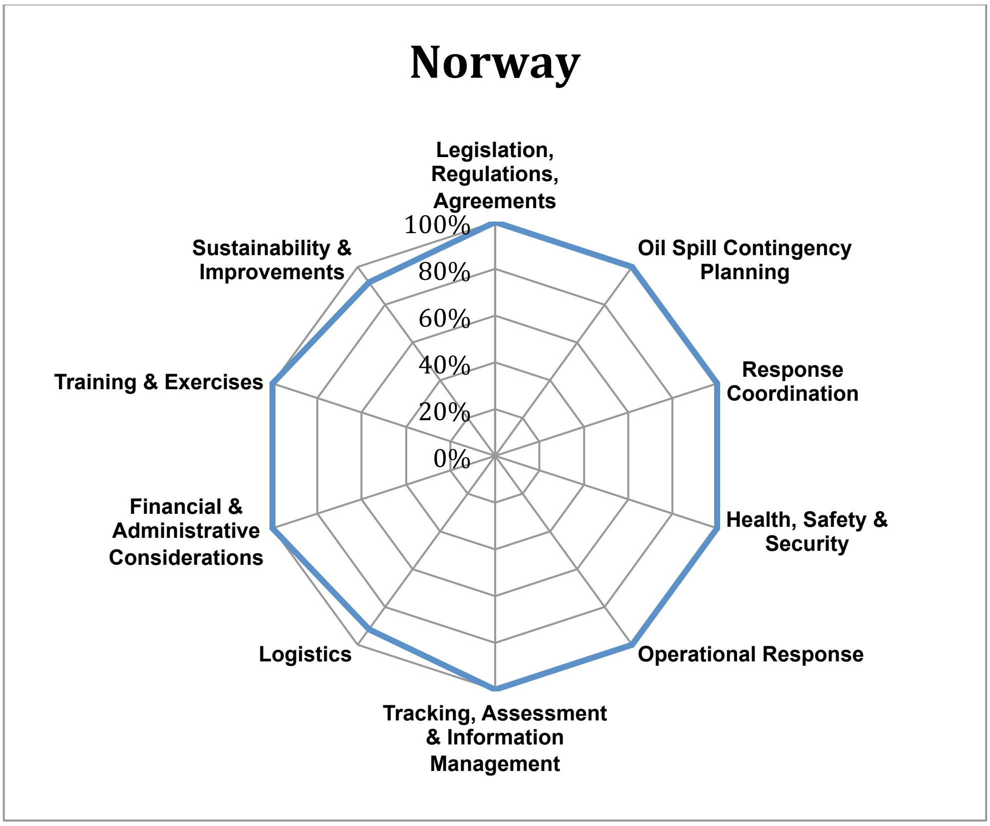
Category	Value
Legislation, Regulations, Agreements	88%
Oil Spill Contingency Planning	59%
Response Coordination	100%
Health, Safety & Security	83%
Operational Response	69%
Tracking, Assessment & Information Management	83%
Logistics	42%
Financial & Administrative Considerations	33%
Training & Exercises	50%
Sustainability & Improvements	58%
Total	**66%**
Institution Specific Criteria	*N/A*
#Completed / Number of questions:	33/ 68
Level A Overall Assessment: 66% (In Development)	

Lithuania RETOS™ evaluation scores



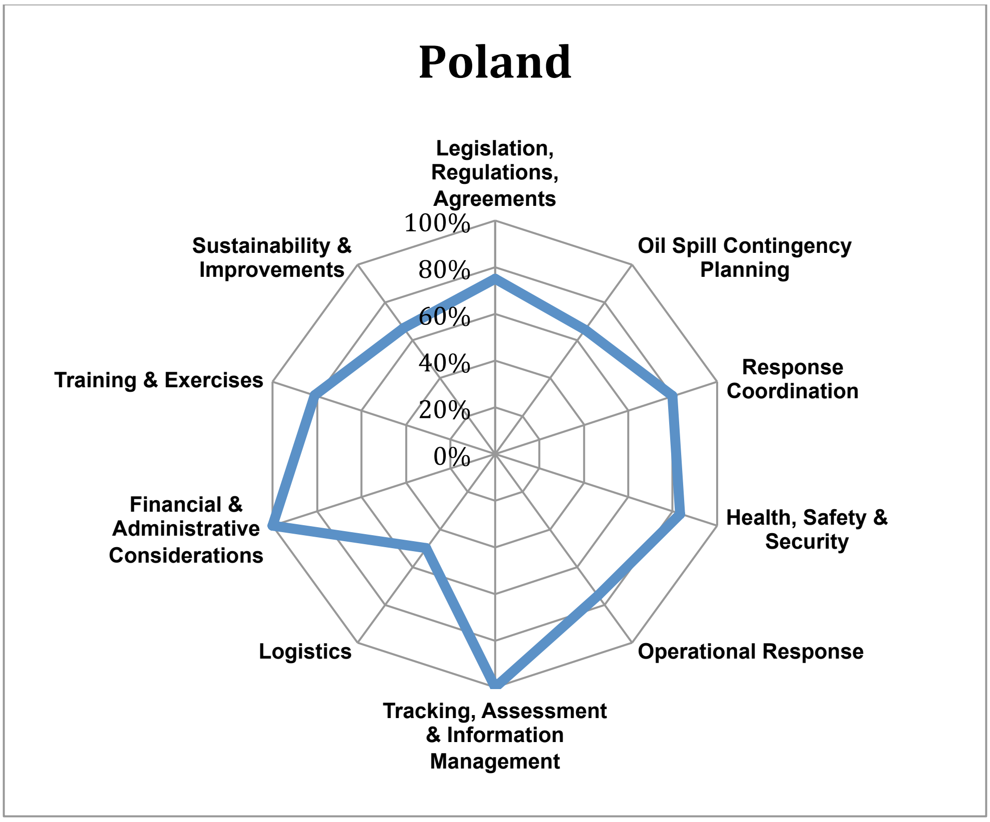
Category	Value
Legislation, Regulations, Agreements	100%
Oil Spill Contingency Planning	62%
Response Coordination	75%
Health, Safety & Security	50%
Operational Response	63%
Tracking, Assessment & Information Management	100%
Logistics	75%
Financial & Administrative Considerations	67%
Training & Exercises	50%
Sustainability & Improvements	42%
Total	**65%**
Institution Specific Criteria	*N/A*
#Completed / Number of questions:	29/ 68
Level A Overall Assessment: 65% (In Development)	

Norway RETOS™ evaluation scores



Category	Value
Legislation, Regulations, Agreements	100%
Oil Spill Contingency Planning	100%
Response Coordination	100%
Health, Safety & Security	100%
Operational Response	100%
Tracking, Assessment & Information Management	100%
Logistics	92%
Financial & Administrative Considerations	100%
Training & Exercises	100%
Sustainability & Improvements	92%
Total	**98%**
Institution Specific Criteria	*N/A*
#Completed / Number of questions:	61/ 63
Level A Overall Assessment: 98% (Completed)	

Poland RETOS™ evaluation scores

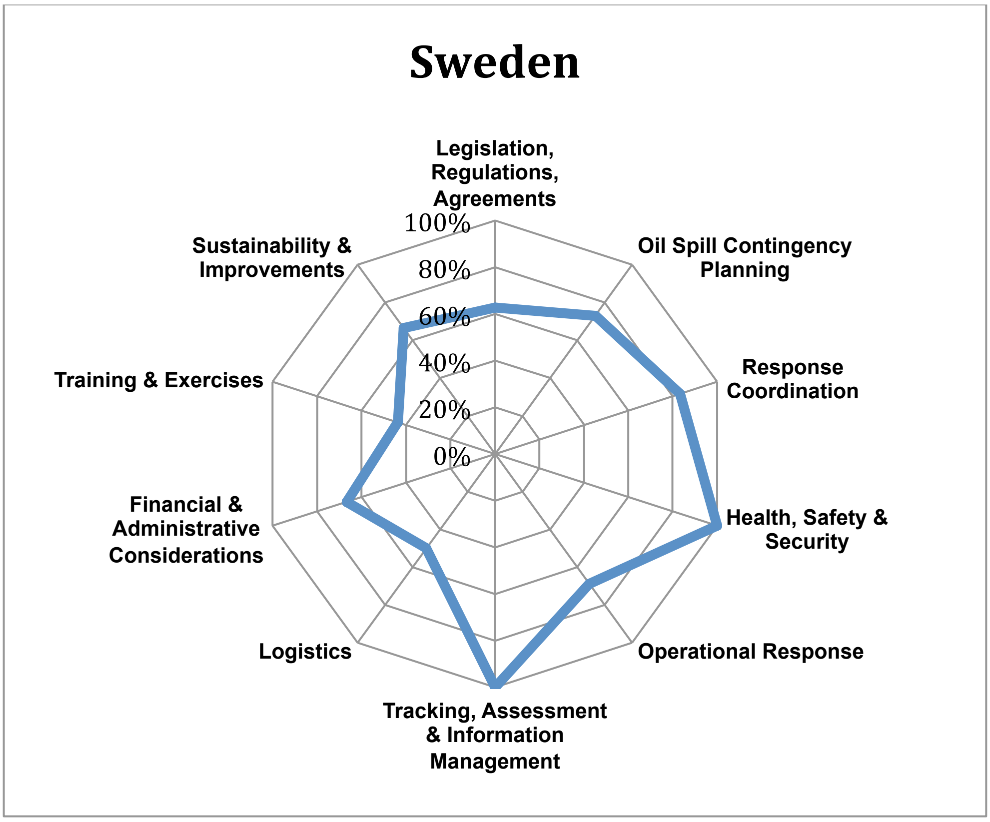


Category	Value
Legislation, Regulations, Agreements	75%
Oil Spill Contingency Planning	66%
Response Coordination	80%
Health, Safety & Security	83%
Operational Response	75%
Tracking, Assessment & Information Management	100%
Logistics	50%
Financial & Administrative Considerations	100%
Training & Exercises	81%
Sustainability & Improvements	67%
Total	**74%**
Institution Specific Criteria	*N/A*
#Completed / Number of questions:	36/ 67
Level A Overall Assessment: 74% (In Development)	

Russia RETOS™ evaluation scores

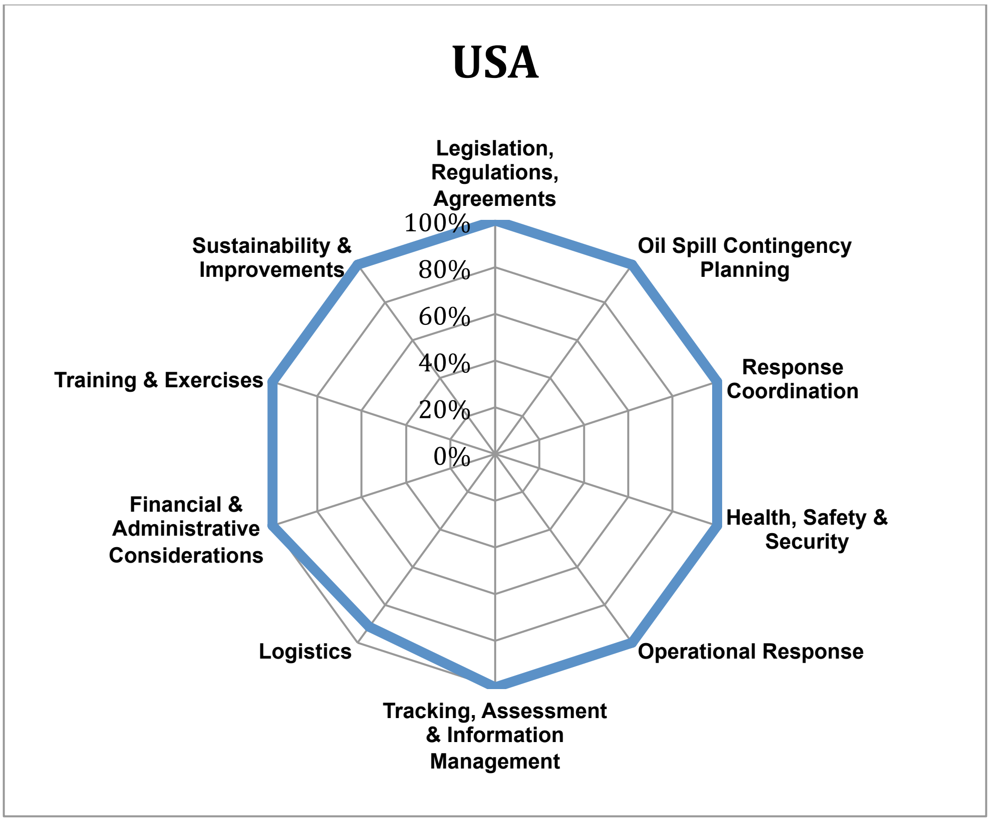
Category	Value
Legislation, Regulations, Agreements	75%
Oil Spill Contingency Planning	80%
Response Coordination	100%
Health, Safety & Security	50%
Operational Response	79%
Tracking, Assessment & Information Management	100%
Logistics	67%
Financial & Administrative Considerations	50%
Training & Exercises	64%
Sustainability & Improvements	42%
Total	**74%**
Institution Specific Criteria	*N/A*
#Completed / Number of questions:	32/ 63
Level A Overall Assessment: 74% (In Development)	

Sweden RETOS™ evaluation scores



Category	Value
Legislation, Regulations, Agreements	63%
Oil Spill Contingency Planning	73%
Response Coordination	83%
Health, Safety & Security	100%
Operational Response	69%
Tracking, Assessment & Information Management	100%
Logistics	50%
Financial & Administrative Considerations	67%
Training & Exercises	44%
Sustainability & Improvements	67%
Total	**69%**
Institution Specific Criteria	*N/A*
#Completed / Number of questions:	35/ 63
Level A Overall Assessment: 69% (In Development)	

USA RETOS™ evaluation scores



Category	Value
Legislation, Regulations, Agreements	100%
Oil Spill Contingency Planning	100%
Response Coordination	100%
Health, Safety & Security	100%
Operational Response	100%
Tracking, Assessment & Information Management	100%
Logistics	92%
Financial & Administrative Considerations	100%
Training & Exercises	100%
Sustainability & Improvements	100%
Total	**99%**
Institution Specific Criteria	*N/A*
#Completed / Number of questions:	67/ 68
Level A Overall Assessment: 99% (Completed)	