

MASTER THESIS

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Emergency response logistics in the High Arctic

- Rescue helicopter coverage in the Norwegian High Arctic in the event of an expedition cruise ship mass- evacuation

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Abstract

The increased exploration cruise ship to the Norwegian High Arctic has raised questions of how salvage of people needing evacuation from a ship in the area should take place. The concept of emergency response logistics represents a research field still in early stages. The context of the study is the increased exploration cruise activity taking place in Arctic waters, along with the particular natural conditions' characteristic for the High Arctic and existing SAR agreements. This paper seeks to explore how variables such as helicopter capacities and fuel depots can affect the rescue capacity, response time of Search and Rescue helicopters and number of people being evacuated if a mass-evacuation is necessary.

Keywords: High Arctic, Arctic waters, Expedition cruise ships, Search and Rescue, Emergency Response Logistics, Helicopter bases, Helicopter capacities, Mass Evacuation

Summary

In rural Arctic seas, time and distance to available emergency response resources is critical if a serious accident in the maritime or petroleum sector occurs, exceeding the vessel's or installation's own emergency response system. A serious and potentially catastrophic ship accident will require assistance from emergency response resources provided by the given nearby ships or national emergency response services. If a ship accident occurs, requiring a mass evacuation from the accident site, helicopter range capacities can be critical for the outcome.

Over the last few years, ship traffic in waters north of 78 degrees has increased with more ships and offshore installations that have brought a large growth in the number of people to visit this part of the world. An effective evacuation following a ship distress call will depend upon the ship's own resources and capabilities but also on how far the distance is to the emergency responders, which will likely include coast guard ships, other vessels and search and rescue helicopters. The locations of helicopter bases can have a major impact on the result of a rescue operation.

Responding to a ship emergency far from the Norwegian mainland is a complex logistical operation. The arctic climate itself adds additional challenges such as cold temperatures that may affect survival and a vulnerable environment that is extremely exposed to the damages oil and other chemicals from the ship may cause. Weather conditions can be harsh and directly affect a rescue operation.

Through bilateral and multilateral agreements, Norway has under the laws enforced by amongst others the Ministry of Justice and Public Security, an obligation to have an emergency preparedness and response system in place for maritime emergencies. The member countries of the Arctic Council have signed an SAR agreement for the High North, where Norway's responsibility includes zones stretching up to the North Pole. The increased activity in Arctic waters has led to additional resources being added to the national emergency response, but there is still a need to strengthen this readiness to ensure a robust and adequate response to significant incidents and accidents in Arctic waters, including when taking into account that passenger and exploration ships in the area tend to increase both in size and number of crew and passengers.

A number of suggestions for improving response capabilities have arisen from various sources due to the increased activity in the arctic maritime region. Norway is responsible for a

large oceanic territorial area with demanding conditions, leading to logistical challenges that are not covered fully with Coast Guard and rescue ships. The locations of helicopter bases on the mainland with available emergency response capabilities such as rescuers and medical crew are of high importance if a serious accident happens in a rural area in Arctic waters. Today Norwegian SAR helicopter services are established in seven different helicopter bases.

This thesis has the purpose of outlining the complexity of logistics during an emergency response situation involving SAR helicopters in Arctic waters, and further to examine the response time of available resources and to look more closely at the location of helicopter bases and the extend of helicopter capacities considering the increased maritime activities taking place in the high north.

The complexity of the logistics and solving emergency preparedness challenges in a demanding maritime arctic environment is a task that requires input from several viewpoints.

Starting with outlining relevant laws and regulations, in addition to international commitments made by Norway to contribute to Emergency Prevention Preparedness Response in the Arctic, this paper further examines the available empirical and theoretical material. Empirical data and important information from interviews with informants from some of the main SAR actors operating in the Arctic are further presented. An analysis is done to answer the research questions. The thesis then presents the concluding remarks and suggests areas that are recommended subjects for further research.

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Bodø, 15th of May 2019,

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List of abbreviations:

ACO: Air Coordinator

AECO: The Association of Arctic Expedition Cruise Operators

AECO TTX: The Association of Arctic Expedition Cruise Operators Table-Top Exercise

AC: Arctic Council

DSB: The Norwegian Directorate for Civil Protection

DCP: Supply chain disaster and crisis pyramid

EPIRB: Emergency Position - Indicating Beacon

EPPR: Working Group of Emergency Prevention Preparedness Response

ERL: Emergency Response Logistics

HNS: Host Nation Support

HRO: High Reliability Organization

IAMSAR: International Aeronautical and Maritime Search and Rescue Manual

IMO: International Maritime Organization

JRCC: Joint Rescue Coordination Centres

LSA: Life Saving Appliances

MARPART: Maritime Preparedness and International Partnership in the High North

MIRG: Maritime Incident Response Group

MRCC: Murmansk Rescue Coordination Center

NAWSARH: Norwegian All Weather Search And Rescue Helicopter

OGs: Operational Guidelines

OSC: On-scene Coordinator

OSR: Oil Spill response

RU: Response Unit

SAR: Search and Rescue

SAREX: Search and Rescue Exercise

SARINOR: Search and Rescue in the High North

SOLAS: International Convention for Safety of Life at Sea

1.0 Introduction

Increased research, exploration and expedition activity along with commercial fisheries in Arctic waters place great demands on emergency response players in the High North. The Arctic consists of 18 million square km sea and only 4 million people are located on the 8 million square kilometers of land (Lauta et al., 2018) The polar sea waters have experienced a steady growth in voyages from the expedition tourism branch and the ships calling at the northernmost ports in the world have increasing passenger capacities. Several challenges can be faced by the actors involved in rescue operations in polar waters and the rapid mobilisation of sufficient rescue resources and capacities can be decisive for the outcome of major events. (Andreassen and Borch, 2018). Oil and gas activities, together with the many cargo and fishing vessels located in Arctic waters, require continuous preparedness from land-based resources that can respond rapidly to an accident. Arctic waters pose challenges such as icing and darkness. Communication even via satellite can be challenging and limited knowledge about the area and missing infrastructure can be factors that contribute to larger, serious events (Andreassen and Borch, 2018)

The Norwegian Rescue Service is operated as a collaboration between public and private emergency response actors. All public bodies with rescue resources are obliged to contribute to rescue services with the resources available (St.mld. No. 86). In Norway, the rescue service – “ Norwegian Rescue Model ”- is subject to the Ministry of Justice and Emergency Planning with the Main Rescue Centers North Norway and Southern Norway (JRCC) as the closest players to the local rescue centres (Jamtli, 2014)

In 2011, Norway signed the Agreement on Cooperation on Aeronautical and Maritime Search and Rescue in the Arctic (Arctic Council, 2011) along with the seven other permanent member states in the Arctic Council: the United States of America, Canada, Russia, Finland, Sweden, Kingdom of Denmark also representing also Greenland and the Faroe Islands, and Iceland (Arctic Council, 2015) This Agreement commits Norway to assist with SAR resources and respond to events in their own agreed territorial areas, and also to provide support to incidents that occur in the signatory member states` territorial responsibility areas.

The agreement further refers to the SAR convention and Chicago Convention as a basis for how search and rescue operations shall be conducted. A political consensus exists among the parties to ensure efficient SAR services in the High North, with a focus on cross - border

support through the Host Nation System (HNS) (Andreassen et al., 2018). The HNS interacts with crisis management based on various principles, among these the responsibility - principle, which state that the organisations responsible for a distress area are also responsible for providing emergency preparedness efforts in case of a crisis or catastrophic event (ibid., 2018: 364). This principle substantiates the large responsibility for emergency preparedness undertaken by Norwegian authorities, taking into account their substantial area of responsibility in the High North.

The IAMSAR manual provides additional guidelines on the Agreement (The Agreement, Article 7). Helicopter resources will most likely represent the most rapid response to a ship accident if evacuation of passengers and crew is necessary. The recent event involving the Norwegian trawler *Northguider* grounding in Hinlopenstredet demonstrated that helicopter assistance was the only passable solution for response and evacuation of the crew, as the nearest ship with adequate SAR resource was more than a 24 - hour voyage away from the location of the accident. This shipwreck occurred during the winter in a harsh and cold environment more than 80 degrees north in a fjord in Spitsbergen, Svalbard.

International maritime safety measures have been addressed by the International Maritime Organisation (IMO) and have been implemented during recent years. One example is the Polar Code which is now part of SOLAS regulations. Although environmental protective requirements apply to all ships operating in polar areas, the safety aspect including emergency preparedness and measures taken to implement for instance personal survival kits for crew and passengers aiming for survival on ice for five days, does not apply to fishing vessels or smaller passenger vessels carrying less than 12 passengers.

It is also relevant to question whether it would have been practically possible to survive for several days outside a passenger or cargo vessel when the area where this shipwreck occurred had a temperature of well below -20 degrees and was in complete darkness. In the case of the *Northguider* incident, helicopter rescue services were vital for a successful outcome.

Available survival kits supplied for survival in the Arctic may help the length of survival of the crew and passengers of a ship; however these kits have been tested with various results and a serious distress- situation will still require a rapid evacuation of those involved.

There is already an arctic exploration cruise expedition company offering arctic adventures from Longyearbyen to the remote Frans Josefs Land at 80°North, 47°East. The 297 ft long *Sea Spirit* carrying a crew of 72 and with passenger capacities of 114, offers an Arctic cruise

to areas where few have been able to sail (Poseidon Expeditions, 2019). The Norwegian Hurtigruten will join the remote exploration cruise to Frans Josefs Land in 2019 with their ship *Spitsbergen*, a vessel able to carry 243 passengers (The Barents Observer, 2018). Hurtigruten will sail via Murmansk, but Norwegian Authorities must still be expected to contribute in case of an incident requiring a possible evacuation as the route is close to their SAR area of responsibility and authorities are obliged by the Agreement signed by their fellow arctic countries.

1.1 Norwegian Search and Rescue helicopters

The background for the public Norwegian rescue helicopter services was several serious accidents at sea after the Second World War. In 1966, Norway had no established Rescue Helicopter service, and had to get assistance from a Danish Search and Rescue helicopter in the SAR operation connected to the M/F *Skagerak* sinking. The Ministry of Justice then started to plan for the procurement of 10 Search and Rescue helicopters. Sea King helicopters were initially produced for locating submarines, but were later used for search and rescue operations. The procurement ended with the purchase of 10 SAR Westland Sea King helicopters, later supplemented with 2 additional Sea King machines, which still form the foundation of the Norwegian Search and Rescue helicopter services today. The Sea King helicopters were delivered in 1973 and are located at the six Norwegian mainland bases with a 15 - minutes response time from when an emergency notification is received. In 1994, the Governor of Svalbard oversaw the installation of one fully equipped Super Puma helicopter based in Longyearbyen (NOU 1997:3,::22-23). This helicopter was later supplemented with another similar SAR helicopter.

Norwegian Search and Rescue helicopter services are today located at seven main bases; Rygge, Sola, Florø, Ørland, Bodø, Banak and Longyearbyen. The helicopters are owned by Norway`s Ministry of Justice and Public Security, and are operated by Norwegian armed forces, where the 330 Squadron is the operator of rescue helicopter services at all bases except Longyearbyen, where the two AS332L1 SAR helicopters are operated by the civilian company Lufttransport.

Norway ordered a total of 16 new SAR helicopters of the model AW101 scheduled for delivery before 2020. These will replace the existing Sea King Helicopters operated from the six mainland bases. The new helicopter project is characterised as the Norwegian All-Weather

Search And Rescue Helicopter (NAWSARH). The NAWSARH project includes an option for securing a delivery of up to six more AW101 helicopters for mainland and island bases before 2022.

1.2 Purpose of this paper

The purpose of this paper is to explore whether Norway will have the necessary helicopter emergency readiness resources available if a major ship distress situation occurs in remote areas based on the scheduled sailing routes of expedition cruise ships. A major logistic emergency mass evacuation operation will be required in order to rescue several hundred passengers and crew members from a large exploration cruise ship in the Norwegian Arctic and carry them to the mainland or a safe area.

Further, this paper seeks to explore appropriate measures that can strengthen the emergency response logistic situation, enabling Norwegian authorities to be prepared in the best possible way to respond to a ship accident in their high north geographical maritime area of responsibility, according to the various SAR agreements signed.

1.3 Research question

To visualise the full extent of the aspects the research questions seek to answer, relevant factors affecting the emergency response logistic are taken into consideration. These include dependent variables such as rescue capacity, response time of SAR helicopters and number of people involved. Further, several intermediate variables are part of the relevant factors included, such as helicopter resource type, including the existing Sea King and Super Puma and the new NAWSARH AW101, location of SAR helicopter bases and location of fuel depots. Lastly, the research model consists of factors including dimensional variables such as traffic patterns, time of year and natural conditions and SAR Agreements. These are all variables that should be considered when examining emergency response logistics in the Norwegian High North.

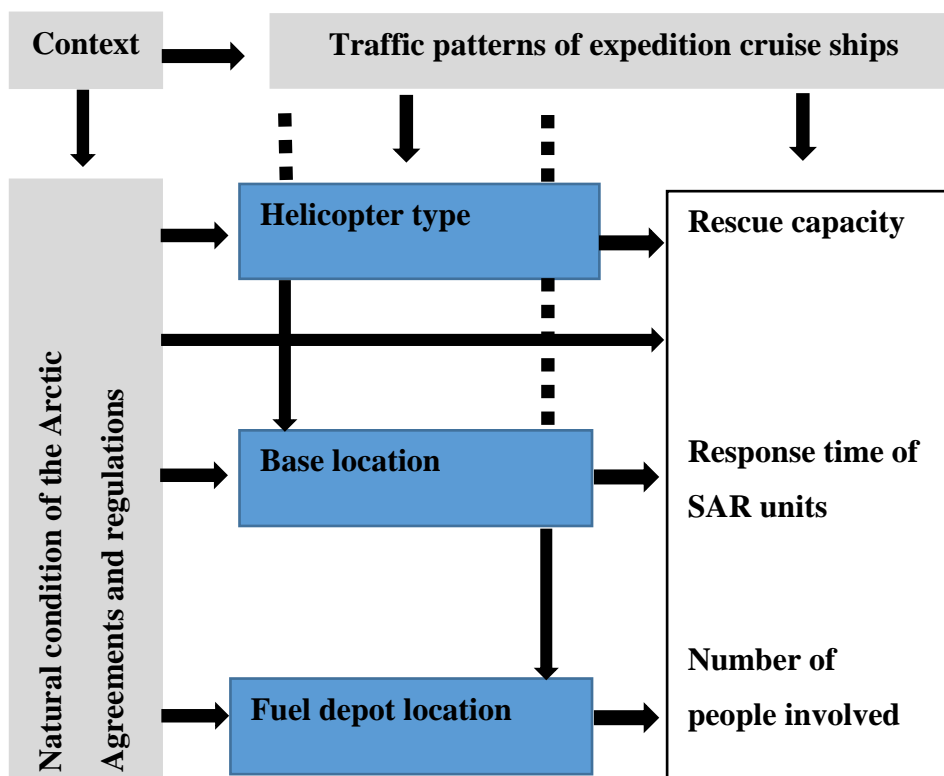


Figure 1: Research model.

The context is compromised by the independent variables shown in the model, representing the increased activity of cruise ships in the High North, the traffic patterns of expedition cruise vessels, the special natural condition's characteristic of the Arctic, and present agreements and regulations for emergency response. The analytical model further visualises the relationship between independent variables which are affected by the intermediate variables, affecting the outcome of a situation, such as helicopter type and location of bases and fuel depot. These intermediate variables are closely examined in this paper. From the intermediate variables, the model moves on to the dependent variables, looking at how the factors rescue capacity, response time, number of people involved can be affected by the intermediate variables.

The dimensional variables in the research model are those limiting the contextual operational conditions. The *traffic patterns* of adventure cruises have during recent years been established increasingly further North in order to attract those seeking adventurous and spectacular experiences. The natural conditions of the Arctic are also a dimensional variable, as the

conditions include ice- covered waters, cold and harsh climate, limitations in sea mapping, and possible limitations in communication coverage. Existing *agreements and regulations*, both international maritime regulations and national and international signed SAR and emergency response agreements constitute the framework for Arctic maritime operations.

One of the three intermediate variables in this paper is *helicopter types*, and is decisive for operational range, speed and passenger capacity. We will look more closely at the capabilities of the existing Sea King and Super Puma search and rescue helicopters compared to the new AW101 NAWSAR helicopter currently being phased in as an SAR helicopter in Norway. Further, the *base location* of SAR helicopters affects the response time and the capability to successfully complete an SAR mission. The last of the intermediate variables in this research model is the location of the *fuel depots*, in case of fuelling need during an emergency response.

The dependent variables include the *rescue capacity* available in case of a major cruise ship emergency necessitating an evacuation. In this paper, helicopter capacity and helicopter type are the main focus when discussing rescue capacity. The *response time* is the time from when a distress message is sent to when SAR units arrive the casualty site. This paper will essentially focus on SAR helicopters, but the response time of maritime SAR resources will also be debated. The *number of people* onboard are highly relevant as a dependent variable, as a ship with several hundred passengers and crew will require a far more extensive SAR operation than a smaller vessel in distress.

This paper seeks to contribute to the studies related to emergency response logistics in Arctic waters. The term *Emergency response logistics* (ERL) can be defined as the *‘Activation (and re-activation) of emergency resources and cooperation between contingency actors at an undesirable event’* (Hammervoll, 2014:17)

and the overall research question is:

Emergency response logistics in the High Arctic - What is the relation between expedition cruise activity and helicopter capabilities in the meaning of a) location and b) helicopter type for mass evacuation in the Norwegian High Arctic?

Sub-question 1:

What evacuation capacities are required in terms of response time and the number of persons needing evacuation on board an expedition cruise ship in the Norwegian High North?

Sub-question 2

In which areas is there a need for rescue helicopter coverage in case a ship evacuation is necessary? Increasing cruise and maritime transport activities in Arctic waters continue to expand Norway`s area of SAR response responsibilities

Sub-question 3

How do contextual factors such as weather and distance to hospitals influence evacuation capacity needs? How do evacuation capacity needs influence helicopter capabilities in the terms of a) helicopter SAR capacity and b) location?

1.4 Research limitations of the thesis

It was necessary to delineate and limit the scope of the research for this paper in order to focus on SAR helicopters based on the mainland and on Svalbard and further SAR helicopter capabilities seen in connection with expedition cruises in the high north.

This scope was chosen as the increased expedition activity appears to have little linear correlation with the amount of emergency response helicopter resources provided to the mainland. An additional base in Troms can support and strengthen the overall rescue capacity

both locally and in an event calling for additional resources being mobilised from the mainland to north of Svalbard to support the SAR helicopters stationed in Longyearbyen.

Several areas of research could have made interesting subjects for a thesis, e.g. factors such as the location and presence of Coast Guard capabilities in the High North. Further, and Ice-classed all-year emergency support vessel could have made an interesting topic in a thesis. Increasing expeditions and continuous high fishery activity in the Barents Sea could have been explored in connection with helicopter SAR capabilities in Troms county. The MIRC team is trained to fight ship fires at sea in the high north. The team is located in Troms County, but since SAR helicopters today have to be mobilised from Banak or Bodø an emergency efficiency study including these factors would make an interesting research topic. Also, the preparedness situation with the re-location of the Bell- helicopters and the delay of the Coast Guard`s scheduled NH- 90 helicopters could have been explored in a thesis.

With the contextual limitations done, this paper seeks to answer the essential questions surrounding expedition cruise activity and helicopter resources available in the high north.

1.5 The thesis structure

The paper offers in its introduction a description of the research, with an analytical model presenting the various variables affecting the case study of Norwegian Search and Rescue helicopter coverage in the Arctic. Chapter 2 introduces the theoretical framework for the thesis. This chapter also presents explanations of key terms such as emergency response logistics, mass evacuations and arctic governance. Further, the chapter outlines relevant existing studies and theories for the area of research concerning maritime emergencies in the High North and emergency response logistics. Chapter 3 deals with methodology and outlines the phases of the qualitative study and how the coding of the data material has been structured and categorised. Chapter 4 consists of relevant empirical data accessed during the research, including existing reports from relevant studies and the context and procedural foundation for the work done by Norwegian SAR services in addition to relevant interview data connected to the reports. Chapter 5 focuses on analysis and findings developed through the research process are discussed in view of the literature presented in the preceding chapters. Conclusions are presented in Chapter 6, with concluding remarks on the thesis`s main- and sub questions. Chapter 7 offers recommendations for future research.

2.0 Theoretical Framework

In this study, the focus is on the theories relevant to emergency resource – related logistical challenges in connection with helicopter evacuations of ship accidents in Arctic waters which necessitate a mass evacuation. Emergency response logistics as a concept is a new field of research in the emergency response literature and does not yet have an international research environment established.

2.1 The crisis concept and emergency planning

Some social scientists have argued that crises are social constructions (Mcbeth et al., 2013) A crisis has various definitions and the concept of a crisis is used in most parts of our society.

According to Rosenthal et al., a crisis can be understood as:

‘Periods of upheaval and collective stress, disturbing everyday patterns and threatening core values and structures in unexpected, often unconceivable, ways’

Further, crises *‘represent a serious threat to the basic structure or the fundamental values and norms of a system, which under time pressures and highly uncertain circumstances necessitates making critical decisions’* (Rosenthal et al., 1989:10)

In this research we focus on crises related to societal disasters and emergency management. Barry Turner discusses in his research how we as a society and as organisations are influenced by intentions, beliefs and assumptions about the world and hazards in the activities we do, and further how we develop norms to avoid hazards (Weick, 1998). A High Reliability Organization (HRO) is characterized by its ability to exist in a hazardous environment where the consequences of an error are high, but the rate of error occurrence is extremely low (Baker et al., 2006) The HRO principle may be applied to major maritime operators, as they do have several measures to apply, both as prevention and if contingency action is necessary. However, they may still be affected by factors beyond their control, such as weather and sea mapping reliability in rural waters.

According to Coppola (2015), there are no common guidelines on how the world`s countries develop their disaster management capacities. Modern disaster management, in terms of the emergence of global standards and organised efforts to address preparedness, mitigation, and response activities for a wide range of disasters, did not emerge until the mid- twentieth century (ibid., 2015). During this period, the government`s role in society became more

evident in the prevention of and response to disasters. The background for the government's increased involvement with prevention and response in terms of civil defence was warfare technology. The regulations and agreements then made to enhance civil defence were the foundation of modern disaster and emergency management as we know it today (ibid., 2015).

When discussing crisis management, emergency or contingency planning is done to develop general and specific measures to prevent and prepare organisation for a rare event (Hafting, 2017:25).

Emergency planning is an important element in crisis management even though the management or co-workers cannot anticipate all undesirable events (Hafting, 2017, Hammervoll, 2014). Social science provides insights into human society and individual relationships (Canton, 2007) Social scientists attempt to decide why something happens. If we take this concept further, it is possible to predict what can occur in the future. Emergency planning can be based on realistic possibilities (Canton, 2007:35).

Logistical concepts and terminologies become more present in emergency planning. According to Brachner and Hvattum (2016), preparedness is driven only by response time. Preparedness planning can also be extended to include response capacity and studies show that the rescue capacity available can be more effective when both operation and emergency planning are done. The planning of both preparedness and response capacity opens for a more effective use of the emergency resources available (ibid.,2016)

In a crisis situation, there will always be multiple actors involved and collaborations will likely be the factor uniting organisations in their work (Richey, 2009) Collaboration means that more than one unit have responsibility for `exchanging common planning, management, execution and performance measurement information` (ibid., 2009:623). A crisis also calls for effective communication and understanding of the norms applicable to communication exchange. Further, communication formalities and correct frequencies of communication aids can be of great importance during crises. Contingency is based on the assumption that things continuously change. Contingency planning in the pyramid can further be influenced by firms or actors simultaneously seeking different, and conflicting strategies this define their position in the supply chain (ibid., 2009)

2.2 Emergency response logistics

Emergency response operations are performed by both public and private actors that are part of complex emergency response networks. The actors are part of an organisation consisting of humans, a social system working on specific tasks such as SAR (Search and Rescue) at sea, supervision or other value- adding activities that are vital for emergency response operations (Hammervoll, 2014)

Emergency response logistics can be defined as the *Activation (and re-activation) of emergency resources and cooperation between contingency actors at an undesirable event* (Hammervoll, 2014:17)

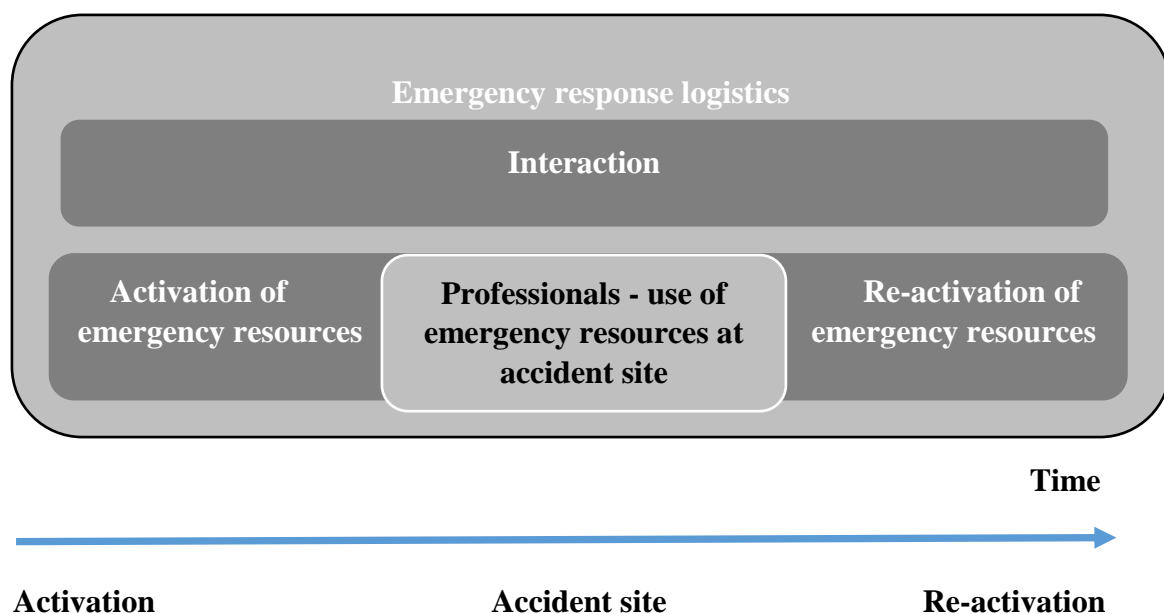


Figure 2: Emergency Logistics Hammervoll (2014)

Emergency response logistics calls for cooperation, exchange of information and planning between actors dealing with preparedness. Emergency response logistics is about this process, when it comes to activation and re-activation of emergency resources and the use of the emergency resources at the site

Emergency logistics can according to Jiang and Yuan (2019) be considered as a very complex dynamic process consisting of many co-dependent tasks with complex purposes and limitations. E.g. after a large-scale disaster, the primary mission is assembling and allocating emergency resources to the affected areas. Research on emergency logistics is still in its early stages. The challenges characteristic for the emergency logistics are shown in the below table.

Emergency Characteristic	Challenge for Emergency Logistics
Large-scale impact	Problem scale and complexity
Severe consequences	Different objectives and decision criteria
Multi-agency involvement	Multiparty collaboration problem
Time pressure and urgency	Critical time requirement and real-time decision making
Demand surge and resource shortage	Allocation of scarce resource
Great uncertainty	Stochastic and scenario based modeling
Infrastructure damage	Logistics with damaged infrastructure

Table 1: Challenges for Emergency Logistics (ibid.,2019:4)

Borch (2016) further explains that `Emergency response logistics consists of planning, facilitating and implementing of production, storage and transport to secure the flow of resources connected to an action in order to reduce the consequences of an undesired event` (Borch, 2016)

Important commonalities when discussing emergency response logistics is further that ;
The situation is to in a large degree a matter of life and death
Rapid action saves lives and values
Time of notification, mobilisation, preparation, consignment of resources and return of injured are critical
Those responsible for the logistics have a great responsibility
 (ibid., 2016)

According to Borch (2016), emergency response logistics (ERL) are further characterised by the following key features:

- 1) Risk of injury to emergency personnel
- 2) Transportation should be effectuated rapidly
- 3) Demanding transport of advanced personnel and equipment

- 4) Emergency site may lack infrastructure
- 5) Materials and personnel are activated from specific units or bases
- 6) High demand for coordination
- 7) A specific type of organisation is responsible for transport
- 8) Operational standards and procedures are followed
- 9) Operations are characterized by uncertainty of what to expect at the accident site
- 10) Need for improvisation
- 11) The need for transportation may be prolonged
- 12) Return transport from site with injured and deceased

When discussing the Arctic region, natural conditions such as major sea areas, harsh weather, lack of daylight and icing are factors influencing ERL. Further, great distances, lack of infrastructure and international security sensitivity are to be taken into account during response to incidents in the region (Borch, 2016)

Emergency response logistics consists of various phases (ibid.2016):

Phases in Emergency response logistics		
Preparation phase	Action- phase	Revitalisation phase
1) Purchase	1) Notification	1) Evaluation and revision
2) Inbound transport to storage/ base	2) Mobilisation of equipment and personnel	2) Maintenance and revitalisation of personnel and equipment
3) Storage management / base administration	3) Outbound transport to accident site	
	4) Establishing and management of front base / storage	
	5) Supply of equipment and personnel to accident site	
	6) Transport of victims	
	7) Exchange and re-activation of equipment and personnel to base	
	8) Re-activation and de-mobilization	

Table 2: Phases in emergency response logistics

2.3 Offshore logistics management

Borch (2016) lists some operational factors influencing offshore logistics management that can be related to maritime activities such as those outlined in this paper, taking place in the High Arctic, where the location of nearby resources may be coincidental. These factors include the type of field the operation is taking place in, and whether it is situated close to other fields or shores, and if there is a lack of infrastructure or the possibility of a joint-operation is not present. Additionally, the organisation of the unit or company will influence logistics management. Distance to available shore resources, the capacity and function of the bases and lastly the weather and climate will impact the management of the operation (ibid., 2016)

2.4 Mass Rescue Operations

Any major ship accident involving several hundred persons on board and possibly resulting in loss of the vessel, necessitates a mass rescue operation. According to the International Maritime Organization (IMO), an incident triggering a mass rescue evacuation can be defined as `an immediate response to a large number of persons in distress so that the capabilities normally available for search and rescue authorities are inadequate` (Andreassen et.al,2018:361)Further, a mass evacuation will include the necessity an effective response. This implies the need for an `immediate, well planned and closely coordinated large-scale action and the use of resources from multiple organizations` (Andreassen et al., 2018:361). Further, in the event of a mass evacuation there is crucial need for information about the scale, complexity and rarity of the emergency situation (Andreassen et al.,2018, Jardine-Smith, 2015). In a major maritime SAR operation, the number of people on board, vessel size, available emergency resources and rarity of the event must be assessed. This will influence the success of the SAR operation, which include several stages such as distress message and allocation of information, planning, operation and rescue (Andreassen et al., 2018).

Borch et al. (2016), describes the scarcity of emergency resources and the increased maritime activity level in the Arctic. The limited capacity of emergency resources, faulty communication lines and other aspects such as challenging operational conditions are factors that put greater demands on SAR operations including mass rescue operation in Arctic waters.

2.5 Cold disaster risk governance

Disaster theory often focuses on disasters occurring in populated and warm climate areas. As human activity in the Arctic and Antarctica has become more increasingly common, attention must be paid to cold climate disasters (Lauta et al., 2018).

The Press- and Release model (PAR model) outlines the relationship between factors that give rise to 'unsafe conditions' (e.g. exposure) (Weichselgartner, 2001). The PAR model views disasters in terms of levels of vulnerability and a disaster is not only caused by a natural event, but also the surrounding social, political and economic environment (Lauta et.al, 2018). When discussing the Arctic region, one can claim that the vulnerability in a cold context is caused by absence of, or distance to infrastructure. (Lauda et al., 2018) Arctic governance system's is according to Oren Young dependent on the relevant biophysical and socioeconomic features. In an Arctic context, the extreme weather, large distances, small population, limited infrastructures and the complexity of the institutional and political landscape both work together and against each other in a 'cold disaster' The Arctic region has various climatic and political features which distinguish it from the rest of the world, calling for cold disaster risk governance. When discussing Arctic governance in relation to cold disasters, there are amongst others two factors that characteristic for the region that need to be considered (Lauta et al. 2018):

1. Adaption with limited resources. The emergency response framework would improve vastly if more investments were made to infrastructure and equipment. Adaption of those resources available, organizations and regulations are necessary
2. Improvisation. Time is essential in an emergency, but especially crucial in cold climates. Limited resources call for improvisation during a crisis response.

2.6 Summary

In this chapter we have examined how the concept of emergency response logistics is concentrated around the interaction, activation and re-activation of emergency resources at an accident site and is influenced by a number of stressors, particularly in the Arctic region. The chapter further explored more specific theories affecting offshore logistics challenges in an emergency response operation. Further, mass evacuation is described as a situation where the need for information about the complexity and scale of the crisis is needed. A mass evacuation further calls for immediate action and normal search and rescue capacities become

inadequate. Performing a rapid and effective response is crucial during a mass rescue, implying the need for well-planned and closely coordinated large - scale action from multiple actors. The PAR model expresses how the social, political and economic environments contribute to disasters. Young claims that the effectiveness of Arctic governance is dependent on relevant biophysical and socioeconomic features. The concept of disaster risk governance further highlights the absence of infrastructure. This calls for adaption of resources, improvisation, upscaling of organisations and negotiation to reach flexible arrangements during a cold disaster.

3.0 Methodology

In this part of the paper a closer description of the research design is introduced. The methodology chapter presents the methods used for data collection including document studies, interviews and field visits. Several methods were used in order to answer the research topic in the best possible way.

In research, it is common to divide between a quantitative and qualitative approach. These are two different paradigms, or methods. Quantitative research is characterised by findings you can measure from a large number of respondents. Qualitative research is characterised by sensitivity to the context in which the research studies are conducted (Tjora, 2017). A qualitative method often places the researcher close to the object or the situation being interviewed or observed. This sense of closeness to the research object create an exciting and explorative method of research. The researcher should however be aware of that the ideas and presumptions held before conducting an interview or observation may need to be adjusted as circumstances may be different to what they expected. As a result of this, the data collection can advantageously be performed in the early stages of a research project. This enables the researcher to adjust both theory and perspective to the empirical analysis (Tjora, 2017). Qualitative research includes several methods, such as analysis of documents, interviews, various observations and field work, and auto-ethnographic methods. This paper is mainly written using qualitative research based on interviews, observations and documents studies. The advantage of selecting interviews and a qualitative approach to the problem in focus is that the research gains in-depth knowledge of the problem in focus. The disadvantage is that the number of informants is limited in qualitative studies, and generalisability is thus not possible in the same way with a quantitative approach using for instance a questionnaire sent by e-mail, which acquire data from a large number of respondents. Some quantitative technical data material also contributes as a foundation to the paper`s analysis chapter, but the case study has a qualitative approach. A qualitative approach will limit the number of informants, but as a single case study is the basis of this paper, it is considered that gaining in-depth knowledge and information from interviews is the most advantageous approach to the problem in focus.

3.1 Research Design

This thesis can best be labelled as a single-case study, characterised by being limited by the case's *environment, phenomenon, type of informants or perspectives and theories* (Tjora, 2017:24). Further, the approach to this study can be described as inductive. An inductive approach is used in research that is explorative and / or is driven by evidence. An inductive method can further be used to conclude a general rule from one or more single cases which can then be applied to your research. (Tjora, 2017:259).

3.2 Data generating process

As an alternative to the term *data collection*, the term *data generating process* is used to signal that empirical data does not exist *out there* but is rather constructed through the research itself. Tjora (2017:256) Agreements, reports and other written documentation from several sources forms the contextual data material used in this this paper. In addition, information from interviews and observations from field visits to SAR actors were used to generate data. Semi-structured interviews were the main data generating source in addition to written documentation. The research subject in this paper consists of three sub-questions with the scope to reveal the situation concerning available emergency resources and the emergency response logistic required to respond to a ship distress call at 80° north. It also raises questions about the special conditions in the High North that may be challenging compared with a similar ship distress call closer to the mainland. Reports and agreements contribute to creating an overview of the current emergency response logistics situation. Through interviews, we are able to *study opinions, attitudes and experience* (Tjora, 2017:114). These two combined methods in the qualitative research field can contribute to answering the research queries in this paper. The data material collected during the research process and from the interviews was sorted and relevant data were selected for use. The subsequent research then included what can be described as an open-code generating process (Nilssen, 2014), which involved categorising of the data material using what Tjora (2017) described as a stepwise-deductive- inductive method. This method aims to develop raw material in various stages, in this case notes and audio files later transcribed into text, into *concepts or theories* (Tjora, 2017:18). The approach can be described as one driven by inductive empiri, though this does not, according to Tjora (2017) lessen the importance of theory.

3.2.1 Document study

Document studies can be used in a wide range of research- topics. Often, they focus on the development of a topic within a given period, which enables us to identify changes or stability within a research area (Brinkmann & Tanggard, 2012). During the writing process it was necessary to study several agreements, regulations, handbooks and articles on research done on the topic. Several of the research documents and articles were published very recent, as they focus on the increased maritime traffic in the high north that has developed over the last few years. It was clear that due to the nature of the Arctic in combination with a new, commercial cruise market developing over the last few years, the study needed to take into account new research papers that have considered the possibility for of major ship disaster necessitating a mass evacuation.

3.2.2 Interviews

The reason we interview people is to *gain knowledge of human experiences from their approach* (Brinkmann & Tanggard, 2012:19). From my study supervisor, I received advice on possible informants to contact in the North of Norway and Svalbard. These individuals were contacted with an informative e-mail, followed up by an appointment for an interview. Most interviews were conducted at the informants` work location. An interview gives the researcher an *opportunity to concentrate on how people experience events, situations or phenomena in their own lives.* (ibid., 2012: 20).

3.2.3 In- depth interviews

The interviews were conducted with a total of nine informants representing Norwegian actors working in areas concerning search and rescue. One of the interviews was done by phone, one by video call and one by e-mail while the remaining were conducted while visiting their work location. After the interview details were agreed upon, interview guides adapted to the informants` work and the research topic of the study were developed. The interview guides is found in appendix 4 of this thesis. Some information in the interview guides has been censored to protect the informants identity. The interviews were initially designed to be focused, with the questions being limited to factors relevant to the research questions. However, already during the first interview, it was apparent that a description somewhere between in-depth and focused interviews was the most appropriate. This is possibly partly due

to the complexity of the study, but also the fact that the interviews were conducted during visits to the informants` place of work. It was natural to be shown around their workplace before or after the interview were conduction. The experience of being able to observe was very useful, and frequently matters that were relevant and unexpected came up for discussion during the tour. Notes were taken during this phase of the visits. During the interviews, audio taping was used for later transcription. As audio taping was done during the research process, the projects had to be notified to Data Protection Services (NSD). The assessment of the study received from NSD stated that there was a low personal data risk. The information letter sent to the informants based on this assessment, is included in appendix III of this paper.

Since all the interviews were conducted in Norwegian, while the thesis is written in English, some context may have been lost during the translation of the transcribed material. All the interview situations were experienced as relaxed yet still involved a high level of engagement from the informants regarding the current SAR situation. The informants spoke openly during the interview situations, and possibly due to a common interest for concern about these matters in the High North, it was easy to establish an informal surrounding without any effort, which Tjora (2017) highlights as one of the prerequisites for succeeding with an interview situation.

Role	Entity	Code
Management	SAR Actor	INF 01
Operational	SAR Actor	INF 02
Operational	SAR Actor	INF 03
Representative	SAR Actor	INF 04
Management	SAR Actor	INF 05
Management	SAR Actor	INF 06
Operational	SAR Actor	INF 07
Operational	SAR Actor	INF 08
Management	SAR Actor	INF 09

Table 3: List of informants

3.2.4 Field visits and observation

Field visits are a method used to gather knowledge, where the researcher observes the group or setting that is being studied (Brinkmann & Tanggard, 2012: 46). Based on the interview-requests sent to the potential informants, it was agreed that the interviews would take place at the various informants' places of work. The visits and observations done in connection with the interviews, gave the researcher unexpected, but very useful input. To observe where the actual SAR- operations are planned and effectuated and to be able to gain knowledge of how the informants work was a very valuable addition to the research. During these observations and visits written notes were taken. The research cannot be described as a field study or observational study, as the interview was still the core method used. However, based on these visits and observations, the foundation of the research paper was strengthened and experiencing and viewing the work in action was a valuable addition to this thesis.

3.2.5 Phone interviews

All except three informants were interviewed in person during visits to their place of work. A planned in-depth interview with one of the informants at their workplace had to be re-scheduled as a video interview due to unforeseen events. Another informant was not listed on the list of informants, but during a phone call made to gain access to another informant, a spontaneous interview was held. This informant had much background information about the search and rescue helicopter situation in Norway to offer, and the notes made during the phone interview led to more research in this area and information gained from this interview and the subsequent further research forms part of this paper. According to Brinkmann and Tanggard (2012:170), 'a phone interview may lead to uncertainty of who the person in the other end are'. The conversation started with both the interviewer and the informant presenting themselves and it was established that they had several common areas of interest, and a light and informal tone was established. The informant then asked if he could contribute with insight, which was very welcome. Notes were taken during the interview, contributing with valuable information that led to additional research.

3.3 Transcription of audio taped interviews

Audit taping were done in two of the interviews and transcribed fully. During the transcribing, there was a focus on follow Tjora's (2017:174) advices to notice details, such as if the

informants paused, and were looking to find words, as this may indicate that the informant is uncertain when answering. One of the challenges that arises during transcribing, is that `visual cues` recorded in the interview are lost while transcribing the interview into written words (Tjora, 2017:175). Another challenge was that the transcribed notes were translated into English, so much time spent on finding the most appropriate translations of valuable quotes and information so that important information was preserved in the thesis.

3.4 Validity, reliability and generalizability

The quality of a qualitative research study can be assessed in terms of the study's `validity, reliability and generalisability (Leung, 2015:325)

3.4.1 Validity

According to Leung (2015), validity in qualitative research can be described as the `appropriateness` of the tools, processes, and data. (Leung, 2015:325). To produce valid research, the researcher seeks to verify whether the research questions have been answered and are valid for the research. Further, to establish if the methodology chosen is suitable for answering the questions and the design, data collection, analysis and results and conclusions are valid (ibid.:325). A combination of analysis of document studies and interviews seeking to answer the research questions and sub- questions concerning helicopter capacities, practical operational challenges, questions concerning helicopter base locations, response time and mass evacuation using a stepwise deductive inductive method (SDI) have been used to code and categorise information, providing material for answers to the questions raised by the study. Tjora (2017:232) describes validity as being connected to the question of whether the responses we find in our research are the answers to what we seek to answer. We can strengthen the validity of a study by clarifying how we practice research based on the questions asked and how these questions are designed, with the foundation being what we seek to explore and established research in the field of study. The current study coheres with newer articles and research in the field. The term emergency response logistics` is an innovative term. Combined with a large increase in exploration cruise activities in the High Arctic during recent years, relevant articles of newer dates have been studied. Exploring this material has resulted in consistency between this study and other available research in the field.

3.4.2 Reliability

While in a quantitative research paper reliability refers to the replicability of the research processes and results, the essence of reliability for qualitative studies lies with the consistency (Leung, 2015: 326), Tjora (2017) describes reliability as whether we are able to determine a connection between the empirical data, analysis and results of a study. The connection between these must not be influenced by personal, political or other unknown factors. Reliability can be summarised as whether if any other researcher conducted the same study as this thesis represents, within the same time frame and surroundings available, the results of the study would be similar.

3.4.3 Generalizability

In most qualitative research, the researcher aims to study a specific issue or phenomenon within a context (Leung, 2015:326) Generalisability is not expected. Due to the increased knowledge offered by qualitative research studies, evaluation of generalisability becomes relevant (ibid.,:326). Leung (2015) further argues that a pragmatic approach to assessing generalisability for a qualitative study is to use the same criteria used to assess validity. Tjora (2017) discusses the term 'conceptual generalisability'. This form of generalisability is connected to the stepwise-deductive-inductive method, seeking to present findings as concepts such as typology, terms and metaphors not necessarily connected to the empirical data foundation or the case of the study. Using this form of generalisability, makes the researcher aware of factors that complement the empirical data by asking questions. Such questions can be whether there are central features with the observations and findings done, and if there are any dimensions in the data that can be used to outline variations in the data collected (Tjora, 2015:246)

3.4.4 Transparency

In any methodological research, a large degree of transparency is considered positive for the quality of the study (Tjora, 2017:266). During the writing of this thesis, there has been a focus on taking notes not only as a form of data collection, but also on the settings and surroundings of the study, trying to establish a commonality and atmosphere for the field of study. This contributes to better communicating how things were done and what considerations were made in this study, such as when choosing informants and processing the collected data. As

for transparency about the research subjects, the study attempts to highlight the unique characteristics of operating in Arctic waters as well as the continuous changes occurring due to increased cruise activity and the questions arising about the current situation and demand for emergency response resources in the event of a mass evacuation situation in the High North. During the coding of the data material the study has focused on identifying cues indicating important findings, so that this thesis will be as relevant and comprehensive as possible. The main goal of this thesis is to provide insight into the rescue helicopter emergency response situation in the event of a maritime cruise accident in the High North. To present this insight expediently, transparency is of utmost importance. To convey the study's insights and findings, some quotations from the interviews have been included in the paper, aiming to give readers the opportunity to get `closer to the empirical data` as Tjora (2015:249) suggests, and not only through the writer of this paper's perspective. The quotations used in this study can be traced to the list of informants and are included in the paper in order to support the conceptual meaning rather than to serve an anecdote

4.0 Empirical Data

In this chapter the empirical findings from the qualitative research are presented, aiming to answer the problem in focus in this thesis. The chapter outline how the Norwegian Search and Rescue services are organised with a focus on notifications of emergencies, principles applied in rescue operations and guidelines for relevant SAR operations. Further, the context of emergency readiness in the Arctic is outlined, such as common projects aiming to improve search and rescue in the high north. The chapter further focuses on the variables considered in the thesis research question, aiming to provide insight and information from both empirical documents and interviews:

Emergency response logistics in the High Arctic - What is the relation between expedition cruise activity and helicopter capabilities in the meaning of a) location and b) helicopter type for mass evacuation in the Norwegian High Arctic?

Sub-question 1:

What evacuation capacities are required in terms of response time and the number of persons needing evacuation on board an expedition cruise ship in the Norwegian High North?

Sub-question 2

In which areas is there a need for rescue helicopter coverage in case a ship evacuation is necessary? Increasing cruise and maritime transport activities in Arctic waters continue to expand Norway`s area of SAR response responsibilities

Sub-question 3

How do contextual factors such as weather and distance to hospitals influence evacuation capacity needs? How do evacuation capacity needs influence helicopter capabilities in the terms of a) helicopter SAR capacity and b) location?

4.1 Helicopter base location

The helicopter SAR bases in Norway include resources with a total of 13 active SAR helicopter units with maximum 1 hour readiness. These helicopters have long range capacities.

Norwegian Rescue Helicopter Resources located by SAR Bases as per March 2019:

Base/ Location	Helicopter	No. of aircrafts	Operator	Replacement with AW101-612 Scheduled:
Longyearbyen	Airbus AS332 L1 Super Puma	2	Lufttransport FW	No
Rygge	Westland Sea King MK43B	2	No.330 Squadron RNoAF	Yes
Sola	Westland Sea King MK43B	2	No.330 Squadron RNoAF	Yes
Florø	Airbus AS332 L1 Super Puma	1	CHC Helicopter Service	Yes
Ørlandet	Westland Sea King MB43B	2	No.330 Squadron RNoAF	Yes
Bodø	Westland Sea King MB43B	2	No.330 Squadron RNoAF	Yes
Banak	Westland Sea King MB43B	2	No.330 Squadron RNoAF	Yes

Table 4: Norwegian SAR Helicopter Base Locations (Luftambulanse, 2019)

In addition, helicopters with SAR capacities are located at the Ekofisk, Statfjord B, Oseberg and Heidrun oilfields. Additional SAR helicopters are placed in Sola, Hammerfest and Vardø. All these are privately operated aircrafts installed to support the oil- and gas industry (SAR Cooperation Plan, 2019)

Light air ambulance helicopters with 15 minutes readiness carrying medical personnel onboard are located at hospitals at bases in Oslo/ Lørenskog, Arendal, Stavanger, Bergen, Førde, Trondheim, Brønnøysund, Evenes and Tromsø. These helicopters do not have long-range capacities and do not normally not operate beyond the Norwegian Coast line (SAR Cooperation Plan, 2019)

Norway purchased a total of 14 multi role military helicopters, NHIndustries NH-90, scheduled to be delivered between 2005 and 2008. Six of the NH-90 helicopters will be dedicated to the Royal Norwegian Navy, while eight of the helicopters will serve in Norwegian Coast Guard duties. A total of eight helicopters have been delivered. However, six

of these are only used for training purposes. Due to insufficient delivery and flight hour completion, the phasing of this project will likely not be completed before 2022 (Riksrevisjonen, 2018-2019). The NH-90 bases are located at the 337 Squadron in Bardufoss, Troms. The other operative base for this aircraft will be in Haakonsværn, Bergen (Norwegian Armed Forces a, 2019) The NH- 90 helicopters can contribute to search and rescue missions (Norwegian Armed Forces b, 2019)

To maintain and improve Norwegian SAR- resources, the Norwegian government has purchased 16 AW101 helicopters for bases located in the mainland of Norway. The project is described as the *Norwegian All Weather Search and Rescue Helicopters (NAWSARH)*, (Aarseth, 2014). The AW101 helicopters will replace the current Sea King helicopters and operate within a multi-use concept within search and rescue, ambulance missions and police assistance with locations at six different main coast bases in Norway; Rygge, Sola, Florø, Ørlandet, Bodø and Banak. The project includes delivery of spare parts, equipment and training packages. The Norwegian Parliament's Proposition 146 S (2010-2011), which deals with the acquisition of the new rescue helicopters, entails an option of the purchase of additional AW101s that can contribute to strengthen the Norwegian Emergency preparedness in Arctic regions with future new bases in Northern Norway and strengthening the response capabilities. Before being implemented, this option must be submitted to the Norwegian Parliament. One of the research questions raised in this paper is whether the Arctic waters will be strengthened by NAWSARH helicopter base placement in Troms and the possible future contribution to the SAR helicopter base in Longyearbyen.

4.2 Helicopter type

One of the main characteristics of the NAWSARH helicopters is that capacities are improved and strengthened for all features compared to the Sea King helicopters covering the Norwegian mainland bases today. The NAWSARH is especially designed for operation in Arctic conditions.

The figure below illustrates a comparison of the NAWSARH AW101 and the Sea King helicopters, currently operating on the mainland.

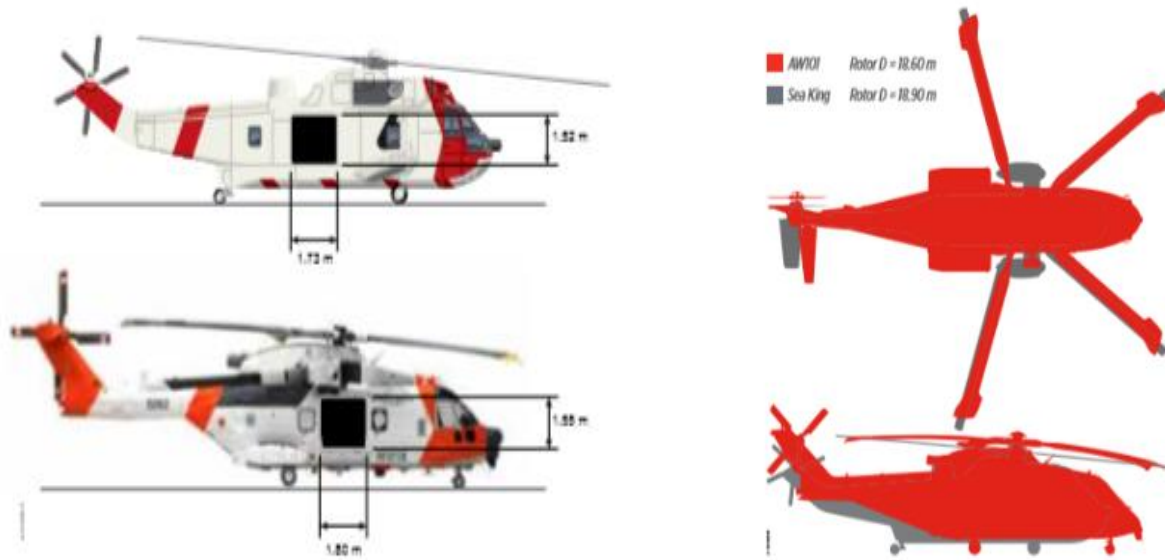


Figure 4: NAWSARH illustration (NAWSARH project)

According to informants, replacing the Sea King helicopters with the AW101s will

represent a capacity improvement what helicopter range, speed and number of rescued people in one helicopter unit concerns` (INF 02, INF 03),

Further the AW101 will, according to informants (INF 02, INF 03) give the mission better margins and the de-icing feature is an important supplement compared to the Sea King when operating in the High Arctic.

It had been publicly discussed whether the AW101 NAWSARH could be a replacement for the two AS332L1 AWSARs on Svalbard. Norway has an existing option opening up for the purchase of additional helicopters before 2022. As Svalbard is regulated by the Svalbard Treaty, there might be implications arising if the Norwegian 330 Squadron is to operate the helicopters as according to the Treaty, there shall be no permanent military presence on Svalbard one of the informants stated. This thesis does not, however, discuss these implications to any great extent. Informants located on Svalbard or working close to Svalbard uphold that there is a great focus on preparedness and that the services provided when it comes to SAR helicopters are good and according to one informant, “*well adapted*”. The current two helicopters have an uptime of 99,31 % (SAR 1) and 89,62 % (SAR 2).

4.3 Response time and the number of people needing evacuation

All ships are equipped with life-saving equipment such as lifeboats, rafts and personal life vests. The trawler grounding in Hinlopen in December 2018 also had other regulations to comply with than a larger expedition cruise ship. A fishing vessel will have survival suits for all those on board, helping to keep them dry and warm, while this is not common on larger ships, where life vests are the standard personal survival equipment. The time factor will be of utmost importance in case of an incident necessitating a mass evacuation from an expedition cruise ship in a cold climate. In Longyearbyen, two SAR helicopters are stationed, and according to the agreement made with Norwegian Authorities for rescue helicopter services, the first helicopter, `SAR 1` should be mobilised within one hour and the second, `SAR 2` within two hours. One of the informants stated that:

`When the alarm goes off, it is never more than 35- 37 minutes before you are in the air`
(INF 07)

When it comes to mobilising SAR helicopters from the mainland to assist north of Svalbard, informants expressed that this would take 9-12 hours depending on the base location.

To evacuate 400 passengers from 80° North and transport them back to Longyearbyen is not an option, according to several informants. It would be necessary to gather situational awareness and find a landing- point where passengers and crew can stay temporarily until further salvage arrives one informant claimed. Such a temporary stay has been discussed with informants, and both a temporary base on land or a base on a larger ship could be an option. There are existing resources on Svalbard that can drop so- called survivor-kits helping the survivors during the first critical hours until they are transported to areas with infrastructure.

During hoisting of survivors from the ship, both visibility and wave height influence the operation. Informants told that one hoisting takes from 1-2 minutes. Weather conditions may affect the operation and pose more challenges to the time used on hoisting. If those on board have more serious injuries, the hoisting will be more challenging and take far more time:

`A hoist operation becomes more complicated with a stretcher; it takes much longer` (INF 07)

4.4. Rescue helicopter coverage in case of a ship evacuation

The dedicated SAR helicopters are today located in six mainland bases and in Longyearbyen. The Sea Kings on the mainland bases are scheduled to be replaced by the new AW101 NAWSARH helicopters. To assist with a mass-evacuation far north of Svalbard and cover Norwegian SAR area responsibility up to 80° north use of fueling opportunities are necessary.

In the event of the trawler grounding in Hinlopen in late 2018, around 104 nm from Longyearbyen, two helicopters were sent, according to one informant, as the initial notification stated that the crew of 14 had abandoned the ship and were in the sea. The second helicopter continued after having been noticed that the crew was still onboard, in order to locate a cabin that could be used as temporary shelter for survivors if necessary. One informant stated that there would have been no problem carrying all the passengers in one helicopter. *‘There is always a plan’*, one of the informants told, and the decision to use two helicopters was taken by the fatigue manager to reduce the time for the first unit above the ship in hoisting position.

This event shows that even though this operation was very successful, a scenario involving 400 passengers will require far more than two helicopters in operation. The SAR helicopters in Longyearbyen have, according to one informant, the possibility to use the fuel depot on Storøya to reach 35° East in the SAR area. Statistics and development in the exploration cruise ship market calls for preparedness. One informant expressed that there is a need for bigger helicopters with longer range in Longyearbyen, while another supported a solution with a third similar helicopter at the Svalbard base set up for long range. A base located in Troms, would according to all informants strengthen the preparedness if helicopters from the mainland bases are to be mobilised north of Svalbard in case of a ship evacuation.

4.5 Contextual factors

Factors that are characteristic for the Arctic compared to the rest of the world, are very important when considering the emergency preparedness. One of the challenges connected to operating in the High Arctic region, is that the communication can pose a challenge.

According to one informant, this was the biggest challenge with the *Northguider* grounding in Hinlopen:

‘They transmitted blindly, and did not get any confirmation that their distress call was received’ (INF 06)

The rescuers were therefore concerned that the crew had abandoned the vessel and was in the sea, in which they would have been faced with a whole different scenario.

Luckily, the informant further explained, they had done everything right. They were wearing survival suits, and the captain brought VHF’s out on deck so they could communicate.

4.5.1 Agreements and regulations

According to international SAR agreements and regulations, Norway is responsible for a substantial search and rescue area in the High Arctic through mutual SAR agreements, as illustrated below.



Figure 4: Arctic Search and Rescue Agreement Areas of Application (Ikkonen, 2017)

According to established international rescue conventions for operations connected to sea and air (ICAO /IMO), a Search and Rescue operation can be divided into five stages (JRCC II, 2018).

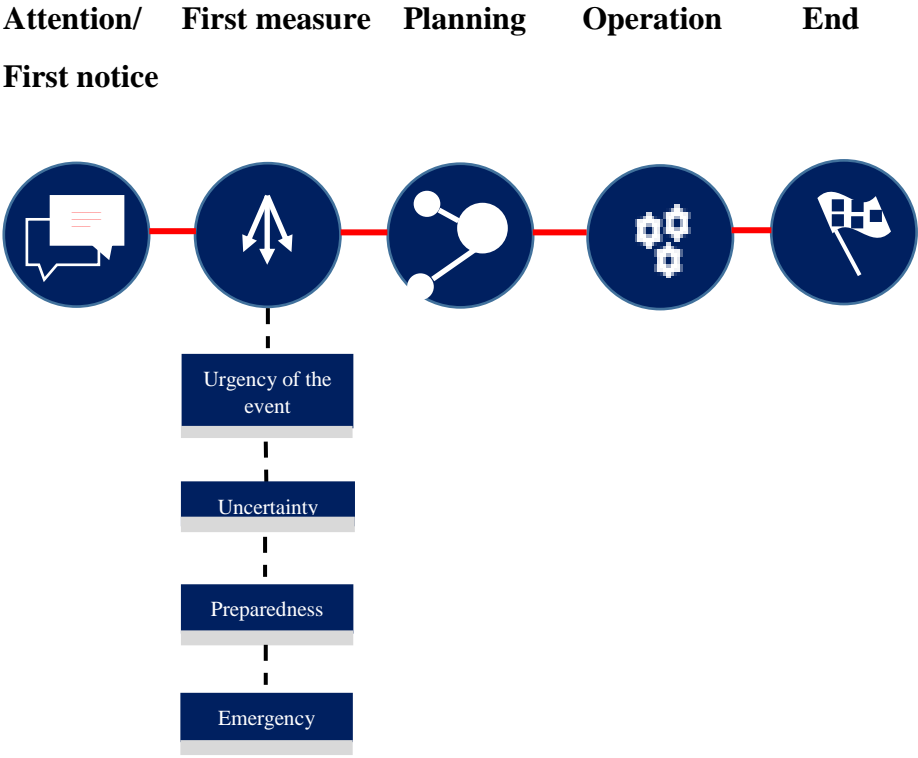


Figure 5: Stages of a Search- and Rescue Operation (JRCC, 2018)

In the first stage, notification of an emergency, or possible emergency situation, is given and received and of a common situational awareness between the Joint Rescue Coordination Centre and emergency services is established (JRCC II, 2018:13). Situational awareness is by multiple informants described as a very important factor in the early stages of an emergency response operation.

In the second stage, measures are taken to alert SAR- actors and gather information. If the situation is critical, SAR resources may be deployed at this stage (JRCC II, 2018:13)

The third stage involve the preparation of the SAR operation, including considerations about how to to facilitate a mass evacuation, transfer survivors to a safe area and planning of receipt of survivals in hospitals (JRCC II, 2018:13).

In stage four emergency resources are activated to the incident site, and coordination and completion of search and rescue and evacuation and transfer of the distressed to a safe area or hospital are carried out (JRCC, 2018:13).

The last stage concludes the Search -and Rescue operation, based on relevant criteria such as a successful salvage and evacuation, or the conclusion there is no longer any hope of finding survivors. This stage involves the de-activation of emergency resources, the follow- up of Next of Kin, debriefing and reporting (JRCC, 2018:13).

In the second stage, the criticality of the rescue mission is determined. This is done on existing information and the criticality of the situation is categorised as one of three levels by defined by the Norwegian rescue services:

Uncertainty. Awareness is established that an incident must be investigated or needs follow-up, but SAR resources are not yet activated

Preparedness. The situation may require assistance, but no critical emergency has been established. SAR-actors may be alerted at this stage.

Emergency: An established emergency situation based on either uncertainty about the situation in the prior level, or information about persons in an emergency that justifies activation of SAR resources.

(JRCC II, 2018:15)

4.5.1.1 Levels of crisis management and the supervision of rescue operations

A rescue operation coordinated by the Norwegian Joint Rescue Coordination Centre (JRCC) is supervised on three levels:

The tactical level, or the first line of response, describes the rescue efforts and resources at the site of emergency. On shore, the tactical level is often coordinated by police departments. At sea, an `On Scene Coordinator`, or OSC, may be appointed if the JRCC finds this expedient, for instance a person with maritime search and rescue experience on board a ship coordinating the rescue efforts between the units involved. In a rescue mission where there is a need to coordinate several aircrafts, as a mass evacuation with helicopters will require, an `Air Coordinator`, or ACO will be appointed by the JRCC. An ACO may execute duties from both shore and air.

The operational level describes the management involved. The management delegates tasks to the tactical level in the rescue operation. Operations at sea are led by the JRCC, and the rescue officer on duty is the main coordinator of the operation assisted by other rescue officers.

The strategic correspond with the management on an executive level, consisting of the rescue leaders in regional police districts and at the two Joint Rescue Coordination Centres. The

management operations at the strategic level shall have a long-term perspective on the planning in order to successfully manage the emergency.

4.5.1.2 Notifications of Emergencies

Norwegian rescue services can be alerted by several means, such as alerts to the national emergency services, coastal radio or directly to one of the JRCCs in Sola or Bodø. In the event of a maritime emergency, JRCCs may request for assistance from other Rescue Coordination Centres and can receive distress calls from Emergency Position- Indicating Beacons. (JRCC I, 2018:66).

4.5.1.3 SAR- notification

There are several notifications sent out when an accident occurs, and one of these is described as an SAR-notification, where the JRCC is included immediately. Such a notification is used when it is evident that rescue services must be involved or when the situation may develop in a way which will necessitate mobilisation of rescue services. An incident as described in this case study, with a distress call from a ship located on 80 ° north of Svalbard calls for a SAR-notification. (JRCC I, 2018:67).

4.5.1.4 Principles applied during a rescue operation

The established main principle for the Norwegian Rescue Service is a `rapid mobilization of enough resources` (JRCC I, 2018:66). A rapid rescue operation is an effective operation if extensive notifications are performed and if the consequences of an emergency is limited as a result of actions taken. A total of three sub- principles apply during a distress situation. The first requires that potential resources are notified as quickly as possible, the second principle is to establish sufficient contact with resources and the third is to pre- notify when the situation calls for the possibility of a rescue operation, mobilising resources in the direction of the emergency and at the same time work on revealing possible threats to the operation, such as weather conditions and local circumstances at the incident site. (JRCC, 2018).

4.5.1.5 Guidelines for a maritime emergency

The Norwegian Rescue Services is founded on the cooperation between public, private and voluntary resources. JRCC has developed and maintained a national guide for planning and collaboration in the rescue service (JRCC II, 2018). This guide outlines a number of scenarios and specific procedures and guidelines to be applied during an emergency. A ship distress event in the High North will require obtaining as much information as possible at an early stage in the emergency. The JRCC procedure for a maritime emergency, hereunder a cruise ship in distress takes into account possible causes such as grounding, collision, fire, leakage

and capsizing. When the first notification is received by the JRCC, the following information is requested from the notifying party:

Situation at the site of emergency

Position. GPS positioning, distance to shore and direction of the drifting vessel

Description of the object, such as vessel type and specification, communication and rescue equipment on board and options available for evacuating the ship.

Number of people involved

Communications means during the operation, such as VHF or EPIRB

Weather conditions at the site such as wind direction, visibility and sea conditions.

4.5.2 Natural conditions of the Arctic

Search and Rescue in the High North, SARiNOR, was established as a framework for the legally binding SAR-Agreement between the eight Arctic Council members (SARiNOR, 2019). SARiNORs` working premises include, in addition to environmental protection aspects, the relevant legal frames and guidelines concerning the search and rescue of human lives in distress in arctic waters. The SARiNOR action plan issued in 2018 was founded on a number of research reports and recommendations made by professional advisors and decision making bodies such as the Ministry of Justice and Public Security, the Norwegian Foreign and Defense Committee and the Norwegian Justice Committee (SARiNOR, 2018) The Action Plan outlined several recommendations to enhance the protection of human lives in Arctic waters as the activity and number of people on board increase:

- `The committee believes that the government should consider Longyearbyen as a hub for search and rescue in the Arctic`

-The committee believes it is important to intensify the survey of the waters around Svalbard and in this connection refers to SARiNOR.

-In the light of unpredictable weather and ice conditions, creating a separate weather radar on Svalbard should also be considered

-The committee also emphasises the importance of training and joint exercises in order to achieve better interaction between actors who are expected to contribute with search and rescue and refer to the SARiNOR project`. (SARiNOR,2018).

The SARiNOR project seeks to unite the various capacities of commercial actors, operating according to minimum requirements set out in international maritime laws and regulations and governmental obligations given by Norwegian authorities. In the Norwegian

government's White Paper on the High North (St. 7, 2011-2012), it is stated that *'The Government will ensure Norwegian ability to carry out rescue services in its own and adjacent rescue responsibilities through maintaining and improving our ability for effective search and rescue'*. Even though commercial actors bear a large responsibility for their operations in Arctic waters, the government needs to ensure that national abilities to conduct search and rescue operations are in place. The Action Plan asks that the Norwegian government consider Longyearbyen in Svalbard as an SAR- hub. This highlights the importance of the placement of emergency response resources in the High North. The SARiNOR committee concluded their report by stating that *'even though Norway already support a large scale of SAR resources, the SAR preparedness is not designed to meet the increased activity and risk of accidents'*. (SARiNOR, 2018:9).

One of the informants highlighted the importance of the SARiNOR project for the development of equipment on board vessels in the High Arctic.

'There is a knowledge-based approach. You have the first- line preparedness where the ship does what it can to keep people alive. Lifeboats, rafts to keep them safe, preferably dry. Once you get wet in the Arctic, the survival rate drops drastically.' (INF01)

The first Marpart report, *'Maritime activity in the High North- current and estimated level up to 2025'* (Borch et al. 2016a) issued in 2016, highlights that there is an increased commercial activity level both in Norwegian waters and Svalbard sea areas; hence maritime activity is moving towards *areas with severe conditions* (ibid.:36). The Norwegian government has listed important changes to be made when developing foreign policy in the Arctic region, stating that there is a need for closer discussions and cooperation among parties involved in activities and multilateral agreements. Further there is a need for more detailed policies, understanding of the northern ecosystem, and knowledge and expertise (ibid.:37).

To enhance and strengthen the emergency preparedness systems and capacities in the High North, Norway will focus on the development of research activities, transportation systems and sustainable economic growth. Through the project Arctic 2030, investments are planned in the region with preparedness and environment as one of the prioritised areas. (ibid.:37, Norwegian Ministry of Foreign Affairs, 2014).

In 2016, the port of Longyearbyen scheduled a total of 36 port calls from 25 different passenger and cruise vessels (Borch et al., 2016a). Many of these ships carried far more than 400 passengers, and in 2019, for instance the *MSC Preziosa* is expected to arrive with a

capacity of carrying a crew of 1370 persons and a maximum passenger capacity of 4345. (Port of Longyearbyen, 2019). As for expedition cruise vessels carrying a few hundred passengers, one of the informants (INF 05) expressed that there will be an increase in visits to Svalbard for over the next few years and that more than 30 new polar class ships will be delivered during the next three to four years in this market segment.

According to the second Marpart project report, Svalbard is distinguished in both natural and social senses and represents different challenges for emergency preparedness systems (Borch et al., 2016b: 50) and further, the High Arctic condition affect the probabilities of accidents occurring given the less developed infrastructure. The report further highlights that the preparedness system have similar incidents occurring on the mainland and Svalbard, such as injuries and missing people. However, since emergency response capacities available for a respond to an accident outside Svalbard are limited, the consequences may be more severe. The report further lists possible variations of events occurring at Svalbard in a matrix of events visualising types of accidents that may occur at sea. These include events of grounding, damages to hull due to collision with sea ice or other obstacles, ship fire, intended undesirable events and other events. The risk matrixes calculating consequences connected to the events, show that for human lives, the risk of significant and serious consequences is high on tourist ships (ibid.,:70) According to the project report, there are conditions in the High Arctic that can affect the likelihood of incidents occurring such as darkness, icing and lack of sea mapping. Weather and seasonal changes are further described as *`dramatic and difficult to foresee`* (ibid.:7). The second Marpart report further summarises that there are limited capacities concerning the mitigation of consequences of large-scale accidents. As the cruise industry in the High Arctic has not established their own SAR and oil spill response capacity as the oil industry are obliged to, the authorities must therefore assess the risks more thoroughly and consider emergency capacities in areas where cruise ship activities are more frequent (ibid.).

4.5.2.1 Joint Arctic exercises to enhance SAR capabilities

Article 10 of the SAR Agreement between Arctic countries states that the parties shall meet, and conduct and review joint exercises and training and based on this review improve guidelines and services (Arctic Council, 2011).

In 2018, the annual Joint Arctic SAR TTX was held in Reykjavik, Iceland. One of the factors highlighted by the participants was the importance of time in a SAR operation; *`The main*

challenge will often be related to helicopter range and limitations. Distances are a challenge` (Joint Arctic SAR ttx Report, 2018:8) According to Schmied (2016), joint exercises can contribute to create *experience-based learning*. Exercises uniting actors in the Arctic both across national borders and areas of competency, can according to Schmied reveal gaps. Incidents such as ship distress that requires evacuation, involving a samaritan vessel. Schmied (2016) further highlights that joint exercises can contribute to experience-based learning in terms of reviewing new standards, regulations and recommendations, for instance the Polar Code. Testing of Life Saving Appliances (LSA) also contributes towards such learning. A joint exercise can also provide insight by testing potential scenarios.

The Barents Rescue is an annual exercise held between Norway and Russia to maintain the cooperation agreement in the search for missing and rescued people in distress in the Barents Sea established in 1954 (by the then the Soviet Union). (JRCC, 2018). The rescue exercises are coordinated by the JRCC North Norway and MRCC (Murmansk Rescue Coordination Center) and the main national SAR actors contribute during the exercise.

The SAREX exercises were held in 2016 and 2017, where actors including the Coast Guard, industry specialists, governmental organisations and academia participated (Jensen, 2018). and Spitzbergen report was issued following a Search and Rescue Exercise which took place off North Spitzbergen in 2016. The weather conditions were excellent, and the participants were healthy. The report concluded that survival in life rafts and lifeboats is significantly reduced after some hours and the exercise was aborted after 24 hours. It was found that if survival in polar waters should be for at least five days, such as the Polar Code guidelines requires significant modifications to equipment and supplies.(SAREX, 2016). According to Jensen (2018), there was *a significant gap between performance of SOLAS-approved lifesaving and evacuation equipment, and the requirements of the Polar Code*. (Jensen, 2018). It was further concluded that a mass evacuation would call for improvisation from those involved. The report concluded that it was not possible to determine how long survival would be possible while waiting to be evacuated by SAR resources in Arctic waters (SAREX, 2016).

The main goal with the Marpart project is to *assess the risk of the increased maritime activity in the High North and the challenges this increase may represent for the preparedness institutions in this region`*(MARPART I, 2019). The Marpart documents focus on which coordination tools and controls should be applied in order to optimize use of resources from a number of countries and institutions (MARPART 1, 2019), and investigates the capacity

needs for challenges related to Arctic maritime operations such as oil spill recovery, firefighting and salvages, undesired destructive events and search and rescue (SAR).

4.5 Fuel depots

It was not possible to get access to a map illustrating fuel depots on the island on Svalbard and surrounding areas during this thesis. However, informants stated that there are a number of fuel depots available in the area and with fuelling, it is possible to reach out to the northernmost areas of SAR responsibility. These depots are supplied by the Governors' vessel *Polarsysse* during the summer, according to one informant.

Some informants stated that fuelling from a depot was very challenging in the winter, while others had not experienced any problems. In the summer, several informants agreed that fuelling from land based depots in the High Arctic is not a problem.

4.6 Summary

In this chapter the information explored during the study are presented. Research that is relevant for emergency response logistics in the High Arctic is further outlined, along with an overview of the procedures applying in a rescue operation for a ship in distress. Input from informants has represented a valuable addition to better understand the complexity surrounding SAR helicopter rescue operations in the Norwegian Search and Rescue area of responsibility.

5.0 Analysis

In this chapter, findings made through the empirical studies are discussed and analysed from the perspective of existing theory within the discipline of emergency response logistics. The relevant variables are discussed and how they affect each other.

5.1 Helicopter base location

From the empirical data review, and the information gathered from interviews, emergency response work in the Norwegian High Arctic pose several challenges, which are not necessarily transferrable to other places in the world.

The overall research question for this thesis was:

Emergency response logistics in the High Arctic-What is the relation between expedition cruise activity and helicopter capabilities in the meaning of: a) location and b) helicopter type for mass evacuation in the Norwegian High Arctic?

To answer this question based on existing data, we had previously found that there is a large increase in the expedition cruise activity to the northernmost areas of the Norwegian SAR area of responsibility. In the event of a ship in distress north of Svalbard, needing support from several outside resources, a mass rescue operation will have to be effectuated.

The helicopter base location will directly impact the rescue capacity, response time and the number of people being evacuated. The natural Arctic surroundings, SAR agreements and increased exploration cruise traffic should further influence the base locations.

To date, there are no regulations concerning co- sailing between ships, and the location of Coast guard resources will be uncertain as they are covering an enormous area of control. A mass rescue operation will require an immediate large-scale action and the use of resources from several organisations. To assist the existing SAR helicopters on Svalbard, helicopters from the mainland can be mobilised. The closest options are then to provide Sea King helicopters from the bases in Banak or Bodø. According to informants, the transfer takes around 8 hours from Banak and up to 12 hours from Bodø.

Refuelling of the Sea King is likely to be necessary one time for the Banak helicopter and two refuelling stops must be done for the Bodø- helicopter during the flight to Svalbard. This also calls for the allocation of resources in the mainland bases as there is already a significant gap in the SAR helicopter coverage.

During an emergency situation, the *activation of emergency resources* is the first step in the process of the emergency response logistics. To ensure the flow of resources to the accident site, it is of great importance that the resources are favourably located. During the research process of this thesis, it was clear that in relation to both distances and activity level, the coverage for Norway's northern areas needs strengthening. As one of the informants stated:

“What we want primarily, is a rescue helicopter base in Troms. The most important thing for us is to get this in place” (INF 01)

And further:

“It will have great importance for the emergency preparedness.” (INF 01)

One of the informants clarified concerning the allocation of resources from the mainland and with SAR helicopters in Troms, that resource can be sent to Svalbard in addition to the Banak helicopter. A great deal of time can be saved in terms of using the emergency resources on the accident site. A helicopter from Bodø can then be sent north to Banak as back-up for preparedness in Troms and Finnmark County.

It was evident during the studies, that a base for rescue helicopters in Troms is wanted in order to cover the enormous area of emergency response responsibility. One of the informants stated that there is a great need for a helicopter base in Troms, given the increased activity and large distances. The informant experienced that there was little will to use resources on preparedness in the North of Norway from central politicians, and further that *“you need to have your preparedness founded in the society if you are going to run a business”*

We can see that an additional base for the rescue helicopters in Troms, will have a significant effect on the preparedness, as also seen in relation to the increased expedition cruise activities outside and north of Svalbard. Locating a base in Troms will contribute to both lowering the response time for SAR helicopters supplied to the existing SAR helicopters in Longyearbyen, and further strengthen the rescue capacity so more people can be saved during a ship in distress in the High Arctic. An additional base can in a phase of mobilisation of resources, strengthen the rescue capacity, lower the response time and contribute to the number of people being saved.

5.2 Helicopter type

The SAR helicopter type influences the rescue capacity, response time and number of people that can be rescued.

The current Sea Kings are scheduled to be phased out from Norwegian mainland bases while the AW101 NAW SARH helicopters are planned to be made operational during the next few years. According to informants, the new helicopter type will contribute to increased capacities in all areas compared to the Sea King, and it also have the important de-icing feature that the current Sea Kings lack. Today`s Sea Kings can`t fly in iced-up conditions, which is not optimal for a SAR helicopter operating in the High North.

We know that time is a decisive factor when speaking in terms of emergency response logistics, and the AW101 takes 45 minutes to travel the same distance that the Sea King will travel in one hour, according to informants. The response time will be considerably lower if new helicopter resources are sent from the mainland to assist an expedition cruise ship north of Svalbard. Their special mission system is being designed for Arctic conditions. According to one of the informants, the new helicopter will be more efficient and give the crew far better tools for SAR operations, and in particular, radars and sensors are highlighted as valuable features. Radars are described as unique and are being especially designed both in terms of navigation and search operations in harsh environments. The sensor will contribute to far better vision, according to one informant.

One of the informants stated that:

“The Sea King can fly 50 nautical miles and save 20 persons. The AW101 can fly 250 nautical miles and pick up 20 persons”.

If two people are to be rescued, the AW can fly 315 nm, while the Sea King can fly 220 nm.

During a rescue operation north of Svalbard, this can be an important feature of the new AW101. To save several hundred people from the north of Svalbard and fly all of them directly to Longyearbyen is not realistic, so a rescue operation that includes transporting healthy survivors to a nearby land point must be planned for, according to one of the informants. In such cases, the addition of AW101 capacity will be valuable, as the helicopter can carry far more people given the correct set up.

The Super Puma helicopters on Svalbard have de-icing features and represents a steady SAR resource on Svalbard. The helicopters are according to one informant:

“Primarily set up for SAR, but also serves the Governor in their many services” (INF 09)

The helicopter also flies ambulance and police services in addition to research missions and as support for key government organisations such as Avinor, Telenor and the Coastal Administration. The SAR base in Longyearbyen also trains the Coastguard ships in helicopter operations, according to one informant.

The AW101 could also contribute to greater capacities on Svalbard. However, the rescue capacity will always be too limited in terms of a mass rescue operation, especially in terms of the challenge in the Arctic where there are great transportation distances. In addition to an immediate and well-planned operation, a mass rescue operation will also require assistance from multiple organisations, such as mainland helicopters. While one informant stated that it is important to have helicopters with greater capacities stationed in Longyearbyen, another informant expressed that a good solution would be to supplement the base on Svalbard with the two AS332L1 AWSARs with a similar additional helicopter and set this up for maximum range.

Any event of a mass evacuation north of Svalbard will be characterised by a large number of people in distress, and the normal resources available in search and rescue operations will be inadequate. There will thus be a need for additional resources from the mainland. If AW101 is stationed in a helicopter base in Troms, this will be a significant addition to the rescue resources in an event taking place on an expedition cruise ship, and contribute to a better coordinated rescue operation as it is possible to allocate resources more rapidly and ensure preparedness in the mainland while the SAR operation takes place on Svalbard.

There is no question that the new NAWSARH helicopter will contribute to a strengthened rescue capacity, lower response time and furthermore, to transport more people. The Super Pumas today represent more suitable helicopters for harsh Arctic environments where icing is a challenge. The Sea Kings has to go around mountains to avoid icing, according to informants. While this paper does not look at the implications with exchanging the helicopters on Svalbard, it is very clear that the AW101 will strengthen the rescue capabilities when SAR helicopter resources have to be allocated from the mainland as it can, according to an informant, fly directly from the mainland to Longyearbyen.

5.3 Response time and the number of people needing evacuation

The response time and number of people needing evacuation are influenced by helicopter type, base location for rescue helicopters and fuel depots in addition to the surrounding context including traffic patterns for ships, Arctic climate implications and various SAR regulations.

During the thesis, some of the informants have been asked how they would have planned for an emergency response towards an incident involving 400 persons, located on 80°North 25°East of Svalbard

Sub-question 1:

What evacuation capacities are required in terms of response time and the number of people needing evacuation on board an expedition cruise ship in the Norwegian High North?

Characteristic for the Arctic are those factors that Lautau et al. (2018) discuss in connection with cold disasters governance. One of the traits associated with the High Arctic is the very absence of, or distance to, physical and social infrastructure. Vessels in the immediate surroundings of a distressed ship are likely to contribute in the salvage, but this may be coincidental, and, importantly, weather conditions, darkness and low temperatures may contribute to SAR helicopters being the only means of evacuation from the distressed vessel to safer surroundings. The call for improvisation is necessary in these situations and as Lautau et al. discuss, 'time is essential in an emergency but especially crucial in cold climates'. An informant stated:

".. the ship does what it can to keep people alive. To keep them safe, preferably dry. Once you get wet in the Arctic, the survival rate drops drastically" (INF 01)

Helicopters will probably stop to refuel during a mass evacuation, to and from the distressed vessel. Helicopters being mobilised from the mainland today also need refueling during the flight on the way over to Svalbard. It has previously been stated by informants that mobilising helicopters from the mainland will take from 9-12 hours with the current Sea King. The new AW101 can reduce the transportation time by 15 minutes per hour and does not need to refuel while flying to Svalbard, according to one informant, so this will shorten the time used for transportation significantly. An additional helicopter base in Troms will contribute to less time being spent by the SAR resources in the north of Norway to the accident site. However, 400 people needing evacuation with helicopters will nevertheless take

hours. Significant time will pass if the incident occurs this far to the north. The Arctic context has, according to Young and Lauta et al. (2018), an institutional and political landscape working both together and against each other. Norway is a member of several SAR collaborations that have been found useful and can ask for assistance from the neighbouring Arctic countries. The same challenges, however, continue to be relevant, such as distances and available SAR helicopter resources.

According to one informant, you should always consider the set-up of the helicopter before departing. *“You need to plan in the best possible way with the information you’ve got available as to what is expected at the site of the emergency”* Again, improvisation is called for when responding to a mission requiring a mass evacuation and in particular, in a High Arctic context when many people need rescuing. Time is a factor that influences the ability to reach people within a reasonable period. However, time is not on your side when it comes to being rescued in the High Arctic with large distances and cold climate. Optimisation of the process of deploying SAR units may contribute to lowering the time used for response. SAR helicopters with larger capacities what speed, passengers and range concerns, and therefore represent a valuable contribution to the essential time factor in terms of evacuation of more people.

5.4 Rescue helicopter coverage in case of a ship evacuation

Rescue helicopter coverage today in the High Arctic affects the overall rescue capacity in the northernmost areas of the world where there is a continuous increase in exploration cruises, and no requirements have been implemented concerning SAR helicopter capabilities in the maritime industry as seen in the offshore sector. The market for exploration cruises continues to grow and at least 30 polar classed exploration ships are scheduled for delivery. We can see that exploration cruises now travel areas further to the north and east, and during their journeys these also pass through Norwegian areas of SAR responsibilities. Questions raised in this concern are therefore relevant:

Sub-question 2

In which areas is there a need for rescue helicopter coverage in case a ship evacuation is necessary? Increasing cruise and maritime transport activities in Arctic waters continue to expand Norway`s area of SAR responsibilities

Rescue helicopters are vital what ship evacuation concerns, and even though it will be practically impossible, according to several informants, to evacuate 400 people within reasonable time from 80° North and 35° East to Longyearbyen, improvisation and adaption of resources can contribute to people being rescued to temporary bases. Svalbard has a number of helicopter depots that can contribute to operation for longer periods of time during a mass evacuation. We can see from the analytical model in this paper, that helicopter coverage is influenced by helicopter type, base location and fuel depot location.

The interaction between the units during a phase with several helicopters on site is of high importance. The rescue helicopter preparedness needs to correlate to the level of activity in the area. As one of the informants stated: *“imagine how hard it would be to employ people on offshore units if they knew there was no way they could be rescued if they needed evacuation”* When no other options are close enough to rescue people within an acceptable time frame, SAR helicopters may be the only solution to reach survivors. Emergency planning can be according to Canton (2007) be based on realistic possibilities and an incident involving an exploration cruise ship must be planned for, because the activity and the possibility for an accident is present.

5.5 Contextual factors

The contextual factors are those that influence the need for SAR helicopter capabilities in order to uphold an acceptable rescue capacity.

Sub-question 3

How do contextual factors such as weather and distance to hospitals influence evacuation capacity needs? How do evacuation capacity needs influence helicopter capabilities in the terms of a) helicopter SAR capacity and b) location?

We know that exploration cruises are increasing in the High Arctic. We also know that the Arctic calls for a cold risk governance. Theories concerning emergency logistics are still, according to Jiang and Yuang (2019) still at an infancy stage. An emergency may cause a large-scale impact and have a number of challenges such as complexity, multiparty collaboration problems, critical time requirements and allocation of scarce resources and lack of infrastructure. These challenges are much more present in the High Arctic, where for example, weather conditions may severely affect an SAR operation. One informant stated:

“We have challenges with icing, mountains and extreme cold in the winter. If you do not get rescued here, you die in no time. We have challenges like sea conditions and drifting ice that affect the operation” (INF 08)

The distance to hospitals is also a factor in terms of injured and hypothermic people. The SAR helicopters have a doctor onboard and the SAR helicopters in Longyearbyen recently got anaesthetic specialists on their units. In severe cases, taking place far from shore the contextual factors such as distance to medical facilities may strongly affect the outcome of a rescue operation.

5.5.1 Helicopter SAR capacities

SAR helicopter resources with sufficient capacities are vital to the preparedness in an area with lack of infrastructure. The AW101 will represent a strengthening of the capacities when being phased into preparedness on the mainland bases. The features on the new helicopters are designed for an Arctic environment, and one informant claims that the unit will receive better real-time information of the awaiting conditions. Information is provided continuously, according to one informant, so the crew can focus on planning the rescue mission on their way to the casualty.

One of the informants also highlighted the importance of situational awareness local knowledge when discussing rescue in the High Arctic:

“You have to be well informed and have local knowledge to operate here. We have many secondary hazards with landing” (INF 08)

5.5.2 Location

The location of the accident will have significant influence as to when, and how many, SAR resources can assist.

As no Norwegian SAR helicopters are located on bases close to the SAR area of responsibility in the north of Svalbard, close to 35° East, the SAR helicopters will have to rely on receiving fuel from either fuel depots on shore or from fuel- carrying ships in the area. One informant talked of so- called Helicopter InFlight Refueling:

“We have ships along the way we can either land and take fuel from or do HIFR if the weather is too poor to land” (INF 08)

The location farther to the north-east of Norwegian SAR area of responsibility is nevertheless very vulnerable in relation to available SAR helicopter capacities. Specifically, this concerns mobilising sufficient helicopters to the site in an event of an evacuation from an exploration cruise ship. Strengthening the preparedness with adequate SAR helicopter resources appear to be an expedient way to meet some of the challenges arising with operating in the High Arctic.

5.6 Summary

In this chapter the variables influencing the rescue capacity, response time and number of people that can be saved are discussed in an analytical context in view of the research model. Factors such as helicopter type, base location and fuel depots are influencing the capacities. The surrounding Arctic context calls for measures, adaption and improvisation in SAR missions. Evacuation of several hundred people from an exploration cruise ship to Longyearbyen with helicopters was not found to be realistic as there is not sufficient helicopter capacity to transport that many people from a ship far from shore within reasonable time. Temporary stay for passengers on nearby bases either on land or on a ship was mentioned by several informants as the best resolution. Strengthening of SAR helicopter capacity and capabilities to support activity in the High North was further found to be very important in a region characterised by increased commercial activity and lack of infrastructure.

6.0 Concluding remarks

There appears to be unanimous agreement among SAR actors in the High North, that the preparedness must be strengthened, based on increased exploration cruise activity and also current activities taking place in the High Arctic.

In particular, SAR helicopter capabilities on the mainland bases that can contribute in events arising north of Svalbard are highlighted. While there are different opinions whether the SAR helicopters on Svalbard needs to be upgraded, an additional SAR helicopter base on the mainland will in any case be a valuable contribution to the preparedness in the High North.

The matter is often a question of financial resources and funding in order to obtain a more robust preparedness. One informant stated that a sufficient understanding of the consequences from a serious event occurring in High Arctic must be established. At the same time Norwegian rescue history shows that nothing happens with the preparedness resources unless a larger event occurs, the informant further expressed.

The logistics surrounding an emergency response related to a mass evacuation, will, in any case depend on resources being mobilised from a number of SAR actors, where the SAR helicopters represents the fastest and most effective response in terms of time and evacuation from a ship. As maritime regulations have not included measures such as co- sailing, helicopter capacities are likely to be the main contribution in the event of an accident involving an exploration cruise ship with several hundred passengers.

The main principles for Norwegian crisis management and preparedness are responsibility, subsidiarity, equivalency and cooperation. If these principles were to be followed, SAR resources strengthening the preparedness in the High Arctic should be provided to include all of the Norwegian population and those visiting the area. What has been obvious while writing this thesis, is that there is a need to cooperate among actors in the Norwegian Arctic to create understanding on a national level of the need for emergency resources. The High Arctic represents a vast area, and to provide sufficient emergency resources, must be a priority. As one informant stated:

“Distance is a key factor for SAR preparedness and capacity”

7.0 Recommendations for further studies

An event leading to a mass evacuation from north of Svalbard will require cooperation and efforts from multiple SAR actors. Several co-operation exercises are already done and in progress. A study with focus on training taking place among SAR actors in the event of a mass-rescue operation in the High Arctic, can make a valuable addition to the development of the preparedness and emergency response.

Further, a study on the measures done by those companies operating cruise- and exploration ships in terms of safety measures and contingency planning could have made an interesting study in the future.

Other recommendations for further studies may include the use of units such as the Orion or Dorniers on Svalbard to create situational awareness, and further explore if the preparedness would have been strengthened if these were to be enrolled as part of the permanent national preparedness system

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Appendix I: List of Documents

Reference	Title	Origin	Type	Date
The Agreement	Agreement on Cooperation on Aeronautical and Maritime Search and Rescue in the Arctic	Member states of the Arctic Council	Legally binding agreement	12.05.2011
SAR Cooperation Plan	SAR Co-operation Plan -Plans for Co-operation between SAR services and Passenger ships in an emergency	JRCC North Norway & JRCC South Norway	Co-operation plan	February 2019
NAWSARH Project	NAWSARH Project (Anskaffelse av nye redningshelikoptre)	Leonardo	Tender information	22.10.2014

Appendix II: E-mail to Informants EN/ NO

Dear Mr/ Ms.

I am currently in the process of writing my master`s thesis in Societal Safety and Emergency Management at North University, Bodø.

My thesis has two research topics: the emergency response logistics necessary to respond to maritime accidents in polar waters and logistics effectiveness concerning the base locations of Norwegian Rescue helicopters.

I am contacting potential informants working in emergency response preparedness organisations to seek further information about these topics.

All the informants will be made anonymous in the thesis. The informant will in any case be given the opportunity to verify quotes intended for use prior to the thesis being submitted.

I would highly appreciate if you are willing to help me by answering these questions, either through a short interview or by e-mail.

I would be very grateful if you are willing to contribute to this thesis as an informant.

Kind regards,

Lisbeth Andreassen Harila

314771@student.nord.no

Phone: +47 95 75 75 95

Masters Degree candidate in Societal Safety and Emergency Management
Nord University, Bodø

Hei,

Jeg skriver for tiden på min mastergradsoppgave i Samfunnssikkerhet og Beredskap ved Nord Universitet, Bodø.

Oppgaven min har to forskningsemner; Beredskapslogistikk; hvilke ressurser er nødvendig for å respondere på maritime ulykker i arktiske farvann og logistikk knyttet til plasseringen av redningshelikopterbasen på fastlands-Norge og Svalbard.

Jeg kontakter derfor potensielle informanter som arbeider i norske beredskapsorganisasjoner for å søke mer informasjon om temaene.

Alle informantene vil bli gjort anonyme i oppgaven og informanten vil i alle tilfeller få tilsendt en sitatkontroll før avhandlingen blir levert. Opptak gjort for transkribering av intervju vil slettes umiddelbart.

Jeg vil sette stor pris på om du er villig til å hjelpe meg ved å svare på disse spørsmålene, enten gjennom et kort intervju eller via e-post eller telefon.

Vennlig hilsen,

Lisbeth Andreassen Harila

314771@student.nord.no

Telefon: 95 75 75 95

Mastergradsstudent i samfunnssikkerhet og kriseledelse,

Nord Universitet, Bodø

Appendix III Information letter about the research project

Deltakelse i Erfaringsbasert Mastergradsprosjekt

«Emergency response logistics in the High Arctic»

Dette er informasjon til deg som har sagt seg villig til å delta i et forskningsprosjekt hvor formålet er utarbeiding av Masteroppgave hvor man undersøker beredskapslogistikk ifm. maritim hendelse nord for Svalbard og helikoptertype og baselokasjon i Høyarktiske strøk. I dette skrevet gis informasjon om prosjektmål og hva deltakelse innebærer.

Formål

Formålet med undersøkelsen er å skrive en erfaringsbasert Masteroppgave ved Nord Universitet i Bodø.

Følgende spørsmål undersøkes i oppgaven:

‘Emergency response logistics in the High Arctic - What is the relation between expedition cruise activity and helicopter capabilities I the meaning of a) location and b) helicopter type for mass evacuation in the Norwegian High Arctic?’

Hvem er ansvarlig for forskningsprosjektet?

Nord Universitet i Bodø, Universitetsalléen 11, 8049 Bodø, Norge

Hvorfor får du spørsmål om å delta?

Utvalget som deltar i intervju er anbefalt av veileder på Masteroppgaven samt gjennom referanse fra beredskapsnettverk.

Hva innebærer det for deg å delta?

- Hvis du velger å delta i prosjektet, innebærer det at et personlig- eller gruppeintervju gjennomføres med aktører innenfor beredskap med bruk av skriftlige notateter. Enkelte av intervjuene gjøres med lydopptak for senere transkribering. Opptak avklares på forhånd i intervjusituasjoner. Eventuelle opptak slettes umiddelbart etter transkribering. Aktuell informasjon fra intervju blir oversendt deg for kontroll. Du kan når som helst be om at innhold endres, rettes eller slettes.

Det er frivillig å delta

Det er frivillig å delta i prosjektet. Du kan når som helst trekke samtykke tilbake uten å oppgi noen grunn. Alle opplysninger om deg vil i alle tilfeller bli anonymisert. Det vil ikke ha noen negative konsekvenser for deg hvis velger å trekke deg.

Ditt personvern – hvordan vi oppbevarer og bruker dine opplysninger

Vi vil bare bruke opplysningene gitt av deg til formålene vi har fortalt om i dette skrivet. Vi behandler opplysningene konfidensielt og i samsvar med personvernregelverket.

Deltakerne vil i oppgaven anonymiseres og bli referert til som «SAR- aktører». Kun godkjent materiale vil bli publisert.

Hva skjer med opplysningene dine når vi avslutter forskningsprosjektet?

Prosjektet skal etter planen avsluttes 15.5.2019. Alle eventuelle opplysninger om intervjudeltakerne slettes før innlevering av Masteroppgaven.

Dine rettigheter

Så lenge du kan identifiseres i datamaterialet, har du rett til:

- innsyn i hvilke personopplysninger som er registrert om deg,
- å få rettet personopplysninger om deg,
- få slettet personopplysninger om deg,
- få utlevert en kopi av dine personopplysninger (dataportabilitet), og
- å sende klage til personvernombudet eller Datatilsynet om behandlingen av dine personopplysninger.

Ingen personopplysninger er registrert i forbindelse med denne oppgaven.

Hva gir oss rett til å behandle personopplysninger om deg?

Vi behandler kun opplysninger om deg basert på ditt samtykke.

Ingen personopplysninger behandles i denne oppgaven.

På oppdrag fra Nord Universitet i Bodø har NSD – Norsk senter for forskningsdata AS vurdert at behandlingen av personopplysninger i dette prosjektet er i samsvar med personvernregelverket.

Hvor kan jeg finne ut mer?

Hvis du har spørsmål til studien, eller ønsker å benytte deg av dine rettigheter, ta kontakt med:

- Nord Universitet ved Professor Odd Jarl Borch, odd.j.borch@nord.no
- Vårt personvernombud: personvernombud@nord.no
- NSD – Norsk senter for forskningsdata AS, på epost (personverntjenester@nsd.no) eller telefon: 55 58 21 17.

Med vennlig hilsen

Lisbeth A. Harila
Student
Nord Universitet

Appendix IV: Interview guides for pre-structured interviews

Emergency response logistics in the High Arctic - What is the relation between expedition cruise activity and helicopter capabilities in the meaning of a) location and b) helicopter type for mass evacuation in the Norwegian High Arctic?

Sub-question 1:

What evacuation capacities are required in terms of response time and the number of persons needing evacuation on board an expedition cruise ship in the Norwegian High North?

Sub-question 2

In which areas is there a need for rescue helicopter coverage in case a ship evacuation is necessary? Increasing cruise and maritime transport activities in Arctic waters continue to expand Norway`s area of SAR response responsibilities

Sub-question 3

How do contextual factors such as weather and distance to hospitals influence evacuation capacity needs? How do evacuation capacity needs influence helicopter capabilities in the terms of a) helicopter SAR capacity and b) location?

INF 01 (SAR management)

1. How would you describe the role of your organisation if you are notified of an emergency on a vessel with the necessary evacuation in Arctic waters, north of Svalbard in the Norwegian SAR area East to 35°?
2. What capacities will typically be mobilised at an event where it is necessary to evacuate 400 passengers from a cruise ship north of Svalbard?
3. How would you describe the situation of available emergency resources in the area?
4. Are there Russian SAR helicopter capacities in the area that may be appropriate to mobilise? - Will Norway be asked to assist in a major rescue operation in the Russian sector?
5. In which areas, in your opinion, is there a need for coverage by rescue helicopter or emergency vessel in case a necessary evacuation situation occurs?
6. Which helicopter resources are desirable and where should they be located?
7. How will an action in the Norwegian zone east of Svalbard be formed, hour by hour, with a combination of aircraft, helicopters and vessel resources?

INF 02 (SAR operation)

INF 03(SAR system operation)

1. What features does AW101 have in bad weather in compared to Super Puma and Sea King?
2. What kind of sensors are important on board the AW101 versus the Super Puma and the Sea King?
3. What are the challenges when it comes to weather conditions for flying and evacuation from a boat?
4. What are the most important threats when it comes to natural conditions in Svalbard?
5. What communication tools does one use in an action, and what kind of limitations do these have?
 - a. Between the helicopters
 - b. Between helicopters and vessel to be evacuated
 - c. With the Governor of Longyearbyen
 - d. With the Main Rescue Centre
6. What are the safety margins and routines for evacuation from boats (visibility, wind) in order to enter and raise passengers?
7. How long does it take to lift a person?
8. What are the safety margins and routines for evacuation from a boat (visibility, wind, meandering, stamping) for landing on a helicopter deck?
9. How would one set up a rescue operation for a cruise ship with 400 passengers east of Nordaustlandet away towards Victoria Island 80 ° N 35 ° E?
10. How many helicopters should participate in such a mass evacuation?
11. How would one co-ordinate these helicopters?
12. How long does it take to fly helicopters up from the mainland to Longyarbyen and further to 80 °N 35°E ?
13. If you are going to transport passengers to Longyearbyen, how long will it take you to get back when bunkering?
14. How long does it take to bunker the helicopter on a depot?
15. How much fuel is stored at each depot?

INF 05 (SAR organisation)

1. Can you briefly tell me about your organisation`s purpose, background and development in number of members?
2. What can you tell about the joint exercises?
3. How would you describe the development in recent years of port calls by larger passenger vessels in Longyearbyen?
4. Do you see an expansion in operation areas for the vessels? (ref. Hurtigruten)
5. What are the main challenges for cruise traffic around Svalbard? (e.g. communication, logistics, distances)
6. What requirements are applicable to vessel masters` calling at Longyearbyen with larger passenger vessels?
7. Do you receive reports of maritime incidents occurring on passenger ships? (reference made [REDACTED])
 - What kind of events are typical in such reports? (medical, technical failure, bottom touch, etc.)
8. How would you describe the emergency preparedness resources on Svalbard if a major maritime event were to occur?

INF 06 (SAR management)

INF 09 (SAR unit management)

1. How would you describe the SAR helicopter preparedness [REDACTED]
2. What capabilities does the helicopter have in terms of carrying range and passenger capacity?
 - a. for short lifting from vessel to shore, e.g. Viking Sky
 - b. for longer trips
3. [REDACTED]
[REDACTED]
[REDACTED]
[REDACTED]
[REDACTED]
4. How would one have set up a rescue operation that involves a mass evacuation from a cruise ship with 400 passengers east of Nordaustlandet away towards Victoria Island (80 ° N 35 ° E)?
5. How long do the helicopters need on average to get mobilised and in the air from the time of the alarm sounding , [REDACTED]
[REDACTED]
6. What kind of limitations apply as to the following:
 - a. How long the pilots can be in action for
 - b. What conditions one can operate under (rules for visibility and wind limitations)
7. How many helicopters should participate in a mass evacuation, and how long will helicopters take when journeying from
 - a) Banak
 - b) Bodø
8. What is important training for you [REDACTED] in the future, in connection with increased cruise traffic in the north?
9. If one is to strengthen the SAR helicopter [REDACTED] what measures should be taken? (more helicopters, longer-range helicopters, etc.)

INF 07 (SAR operation)

1. [REDACTED]
2. What are the biggest operational challenges in the High Arctic?
3. How long do the helicopters need on average to get mobilised and in the air from the time of the alarm sounding?
4. How do you prepare for events?

INF 09 (SAR operation)

1. Can you tell me about important factors surrounding SAR- operations in the High Arctic?
2. Mass rescue operations; how can you prepare?
3. How can the emergency preparedness in the High Arctic be strengthened?