MASTEROPPGAVE

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Aerial unit coordination by an Aircraft Coordinator (ACO) in large scale search and rescue operations in the High North

- as seen in a Norwegian Arctic perspective

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Abstract

In the Norwegian Search and Rescue (SAR) system, there are two Joint Rescue Coordination Centres (JRCCs) responsible for the conduct of SAR operations. These are for the Northern and the Southern part of Norway situated in respectively Bodø and Stavanger. When a situation evolves far out to sea, or anywhere else for that matter, these two JRCCs will make use of whatever resources are available in order to save lives. At sea there have for many years been an established relationship between the responsible JRCC, and an On Scene Coordinator (OSC) responsible for the coordination of surface units in the SAR area. In the Norwegian Search and Rescue Region (SRR), a Norwegian Coast Guard vessel (NoCGV) will most often be appointed this OSC role.

In the aftermaths of two ship cathastrophies in the late eighties/early nineties, one in the North Sea/Skagerrak, and one in the Baltic Sea, SAR officials in both Sweden, Finland and later Denmark, started to look into how coordination of aerial units could be improved. The result of these efforts were specific Aircraft Coordinator (ACO) procedures intended to provide both flight safety for, and SAR efficiency from, the participating SAR units (SRUs). These procedures were up until recently only approved for operational use by Denmark, Finland and Sweden. From 1 July 2016 the procedures are included in the new edition of the International Aeronautical and Maritime Search and Rescue (IAMSAR) manual. Effectively implementing these more specific procedures formally into the Norwegian SAR system. As Norway is obliged to, by its membership in the International Maritime Organization (IMO) and the International Civil Aviation Organization (ICAO).

The procedures have in the latter years been used in a few large exercises in Norway. This thesis discusses the formal introduction of these more detailed Aircraft Coordinator procedures into the Norwegian SAR service. First and foremost in terms of how the role of an Aircraft Coordinator will enhance operative performance from aerial SAR units (SRUs) in large scale SAR operations in the High North. But also in terms of what measures will have to be taken to build competence, and provide for training and exercise of all stakeholders, in the system.

In the pursuit of answers to these research questions, a broad empirical material has been looked upon using several theoretical perspectives.

The results of the analyzing process have been conclusive, and to some degree surprising. In regards to the High North aspect, it is noted that the ACO procedures are

designed in a way that make them ideal for use over the sea and over vast distances. The procedures simply fit the High North and vice versa. The two only ACO candidates able to cover the High North dimension, the Norwegian Coast Guard vessels and the P3 Orion maritime patrol aircraft of the 333 Squadron, are on a daily basis situated in the very centre of High North activity. Hence the civil-military dimension of the Norwegian SAR system remains the only possible remedy to handle large scale SAR situations in Arctic waters successfully.

On the JRCC´s part, lack of communication north of (stable) radio-, radar- and even satellite coverage, and the subsequent lack of present time on-scene situation awareness (SA), remains a major issue. This lack of updated information hampers the JRCC´s ability for direct timely decision-making in dealing with these worst case scenarios. Although there are very promising solutions, with regards to both broadband and chat-communication towards the NoCG vessels being tested, this thesis argues that competence in combination with the ACO´s ability to improvise, must be seen as the answer to the shortcomings in communication.

Competence in ACO procedures, at a level where confidence kicks in, demands formal theoretical education, in addition to training and exercise. The annual cooperative Exercise Barents between Norway and Russia, have proven to be less than optimal when it comes to ACO procedural training. Formal complications regarding border crossing, together with language barriers, often reduce the potential output for the ACOs.

The remedy to this, I suggest to be small-scale ACO-procedural training. This type of training will ensure that all necessary personell gain insight into the procedures, and not only the one or to crew present at the large scale exercises. The planning for this type of training can be conducted at the tactical level by the SRUs and ACOs themselves, and thereby making it possible on a more frequent basis. The key players; military and civilian helicopters, the NoCG and the P3 Orion MPA, are flying, sailing and training on a daily basis anyway, to put it simple.

But in order for this to be achievable, the theoretical foundation must be laid. And also this is not seen as a demanding task, as it is identified that the Royal Norwegian Navy (RNoN) has both the resources, the locations, the ability and the will to arrange theoretical ACO courses, including simulator training. Until this is in effect, one can not expect the ACO procedures to have full effect on the operative performance of the Norwegian SAR system.

Foreword

The task of writing a master thesis, have at times been a challenging one. But when writing and investigating something that is interesting, and feels important, the task becomes manageable. And when the task leads to interesting knowledge, and interaction with enthusiastic experts in the field, it even becomes enjoyable! The certainty that the process has lead to increased personal competence, then becomes a mere bonus.

During the research process, my supervisor professor Odd Jarl Borch at the Business School /NORD University, have provided me with timely poking in the form of e-mails, kindly asking for an update on my progression. In addition to this, he has been practising an open-door policy which has made me feel confident that the necessary guidance and help has been available throughout the process. For this, and numerous relevant articles in my inbox, I want to thank him.

Also my employers during this process, the Norwegian Joint Headquarters, and the 330 Squadron of the Royal Norwegian Air Force, deserve my gratitude, as I have been granted permission to both study, attend courses and seminars relevant to my topic. I also want to thank numerous persons of the Joint Rescue Coordination Centers, the Royal Norwegian Naval base at Haakonsvern, the Norwegian Coast Guard and the different helicopter squadrons of the RoNAF. It would take up too much space to name all, but you have all shown me confidence by sharing your expertise with me. I *will* have to name Warrant Officer Jan Lindekilde Thomsen at the JRCC Denmark, inspector Ørjan Delbekk at the JRCC North/Norway, and Subject Matter Expert Helicopter Control LtCdr Bjarne Pettersen at the Helicopter Department Naval Training Establishment HNoMS Tordenskjold, as they have provided me with information, enthusiasm and out-of-what-can-be-expected support.

And last, but not least, I must thank my wife Nina, and my three little girls Dina, Vilja and Ylva, for putting up with me isolating myself with headsets, about 1 meter from their living room. And; sorry for forgetting the bread in the oven on the last evening of writing! Eating semi-burned bread for a couple of days, did not in any way ruin the joy of completing this thesis.

Hopefully it can serve as a small contribution to the continous improvement of the already excellent Norwegian SAR system.

Bodø 7 June 2016

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Glossary of abbreviations and acronyms

ACO	Aircraft Coordinator
ATC	Air Traffic Control
ATS	Air Traffic Service
COP	Common Operational Picture
CSP	Commence Search Point
CSS	Coordinator Surface Search (a term previously used)
ERO	Emergency Response Organization
HCO	Helicopter Control Officer
IAMSAR	International Aeronautical and Maritime Search and Rescue (Manual)
IC	Incident Commander (Police)
ICAO	International Civil Aviation Organization
IMO	International Maritime Organization
JRCC	Joint Rescue Coordination Centre
METOC	Meteorological and Oceanographic
MPA	Maritime Patrol Aircraft
MRCC	Maritime Rescue Coordination Centre
MRO	Mass Rescue Operation
NJHQ	Norwegian Joint Headquarters
NM	Nautical Miles
NoCG(V)	Norwegian Coast Guard (Vessel)
OSC	On Scene Coordinator (earlier: On-Scene Commander)
OSC-Air	On Scene Coordinator Air (a term previously used, pre-ACO)
RCC	Rescue Coordination Centre
RPA	Remotely Piloted Aircraft (systems)
RSC	Rescue Sub-Centre
RoNAF	Royal Norwegian Air Force
RNoN	Royal Norwegian Navy
SAR	Search and Rescue
SMC	SAR Mission Coordinator (in Norway - an operator at JRCC North/South)
SRR	Search and Rescue Region
SRU	Search and Rescue Unit

1 Introduction

The Norwegian search and rescue (SAR) system has many stakeholders. Governmental, military, voluntary and commercial agencies and units are all expected and instructed to participate when the situation so demands. The units and personell directly participating in the frontline of search and rescue operations, range from professionals with search and rescue as their sole purpose, to voluntarily organizations participating out of sheer dedication (Ministry of Justice and Public Security, 2002).

To coordinate all these different players in a challenging situation, puts high demands on the two Joint Rescue Coordination Centres (JRCCs). The JRCCs have the overall responsibility for the handling of the operation, as well as the resource allocation to it. Even though they will in most circumstances be directly involved in the handling of a SAR-situation, they must in some aspects be considered to be on the operational level. In order to be able to coordinate operations at a tactical level, there is in some cases also the need for a coordinative element closer to where the actual situation plays out. Ashore the police will be this tactical level coordinator as a Rescue Sub-Centre (RSC) (Organizational Plan for the Search and Rescue Service, 2015). At sea this function is adhered to by a person acting as the On Scene Coordinator (OSC). This person will in each case be appointed by one of the two JRCCs. In Norway most often this task will be given to the commander of a Coast Guard or other military ship, although situation and availability certaintly may dictate otherwise. According to the International Aeronautical and Maritime Search And Rescue-manual (IAMSAR-manual) the On Scene Coordinator is defined as;

”*…a person designated to coordinate search and rescue operations within a specified area*.” (IAMSAR Manual VOL II, 2013)

Up untill the late 1990s, also the task of coordinating *airborne* units in a SAR-operation would be put upon the OSC. In demanding situations with several aerial units involved, the OSC would have to be supported by relevant personell, e.g. air traffic controllers. But often this type of personell would arrive at the scene too late for them to have a proper impact on the outcome of the situation. Like in the case of the *MS Estonia* ferry disaster, where this type of personell arrived 45 minutes after the last survivors were rescued (The Joint Accident Investigation Commision, 1997). From this, and other similar disasters the need for a more formal and preplanned coordination of aerial resources involved in search and rescue, emerged. The problem has been adressed by appointing a person or team as ACO.

And while the ACO earlier was seen as subordinate to the OSC, and earlier issues of the IAMSAR manual mentions the aircraft coordinator as a sort of a sub-coordinator, the new edition of 2016 will formally establish a relationship of equality between the OSC and the ACO.

1.1 The need for an Aircraft Coordinator

Like the OSC the role of ACO is also appointed by JRCC in each case. The ACO is according to the current IAMSAR manual defined as;

"...a person or team who coordinates the involvement of multiple aircraft SAR operations in support of the SAR Mission Coordinator and the On Scene Coordinator" (IAMSAR Manual VOL II, 2013).

In the coming 2016-issue of the IAMSAR-manual it is according to drafts stated that SAR-authorities will designate *a person, unit or organization* as an ACO (Draft new IAMSAR manual VOL II, 2016).

The role of an aircraft coordinator (ACO) in SAR operations is a relatively new phenomenon, and therefore in some aspects still in the making. The exercise Skag Ex in 2011 included the first major test of the ACO-function in the norwegian SAR service. (The learnings from Skag Ex will be adressed later in this paper). The new 2016 issue of the IAMSAR-manual has this wording on the need for an ACO;

"Whenever two or more aircraft are taking part in a SAR operation and are likely to operate close to each other, a person, unit or organization should be appointed as an Air Coordinator (ACO)" (Draft new IAMSAR manual VOL II, 2016).

One can easily foresee today that*"..two or more aircraft.."* will participate in any larger incident where there is a need for helicopter rescue.

As the number of SAR helicopters along the Norwegian coastline have increased in the latter years, also in the High North, there will now be a much larger need for coordination of these resources in the case of a large scale search, rescue or evacuation operation. As shown in figure 1, 25 years ago, coordination of rescue helicopters in the Norwegian search and rescue region (SRR) were less likely to be imperative. In short, because there were not many potential SAR helicopters to be involved in any one incident.

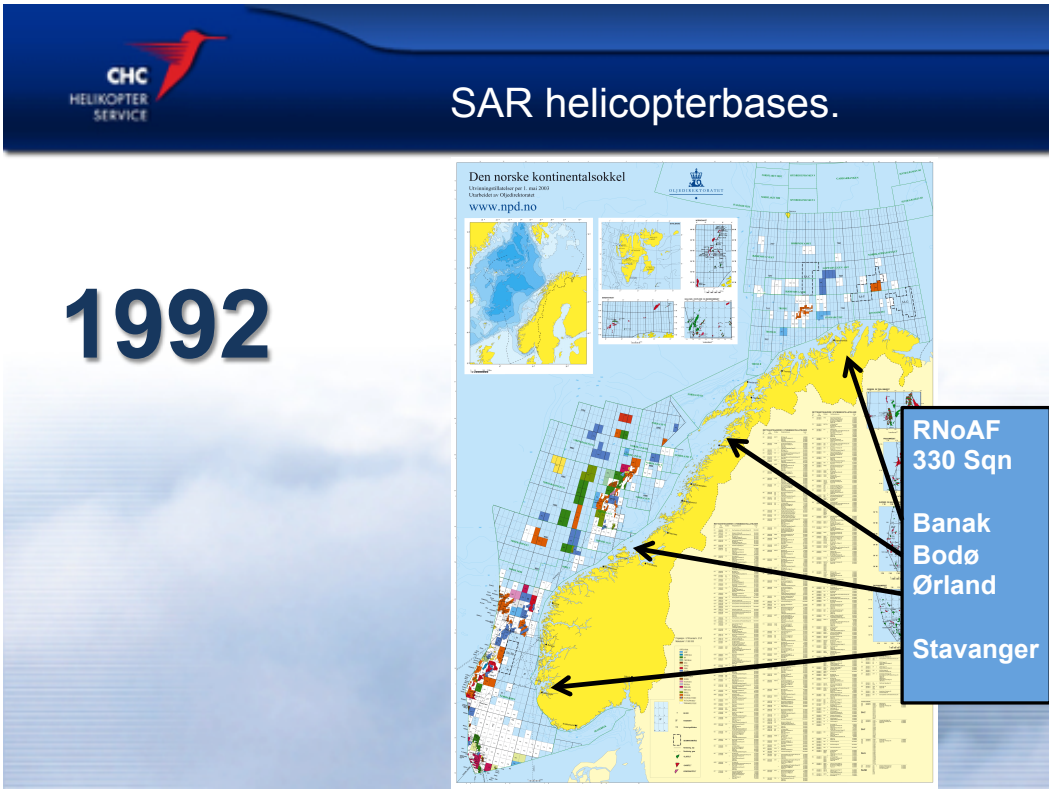


Figure 1: Number of Norwegian search and rescue helicopter bases by 1992 (Illustration by courtesy of CHC Helicopter Service).

Even so, when the Soviet cruise ship *Maksim Gorkiy* collided with an iceberg in 1989 some 160 nautical miles west of Spitsbergen, there would after a few hours be several aerial units arriving on the scene. And therefore also a need for the coordination of these would appear already then. In the book *"Redningsdåden" ("the Rescue deed")* by Sølve Tanke Hovden, the commander of one of the Norwegian Sea King SAR helicopters tells (translated from Norwegian):

"The Orion (maritime patrol aircraft) reported that two Soviet helicopters from Barentsburg were on a colliding course with us, but at an unknown altitude. This meant we had to climb to 5000 feet, and to a safe position north of the vessel in distress, before we could descend through the clouds". (Hovden, 2012:64)

At some point there were six helicopters and two planes in the area of operation around *Maksim Gorkiy*. Today the picture is potentially much more complex. As shown in figure 2, the number of SAR bases for helicopters has increased significantly along the Norwegian coast. In addition to this, both the Norwegian Coast Guard and the Norwegian Navy will within the next few years have SAR capable NH-90 helicopters embarked on their ships. So in the case of an accident, even in the High North, there will soon be numerous

helicopters involved in an operation. And in addition to this comes the eventuality of helicopters from neighbouring nations, airplanes and in a not so distant future also remotely piloted aircraft (RPA) systems.

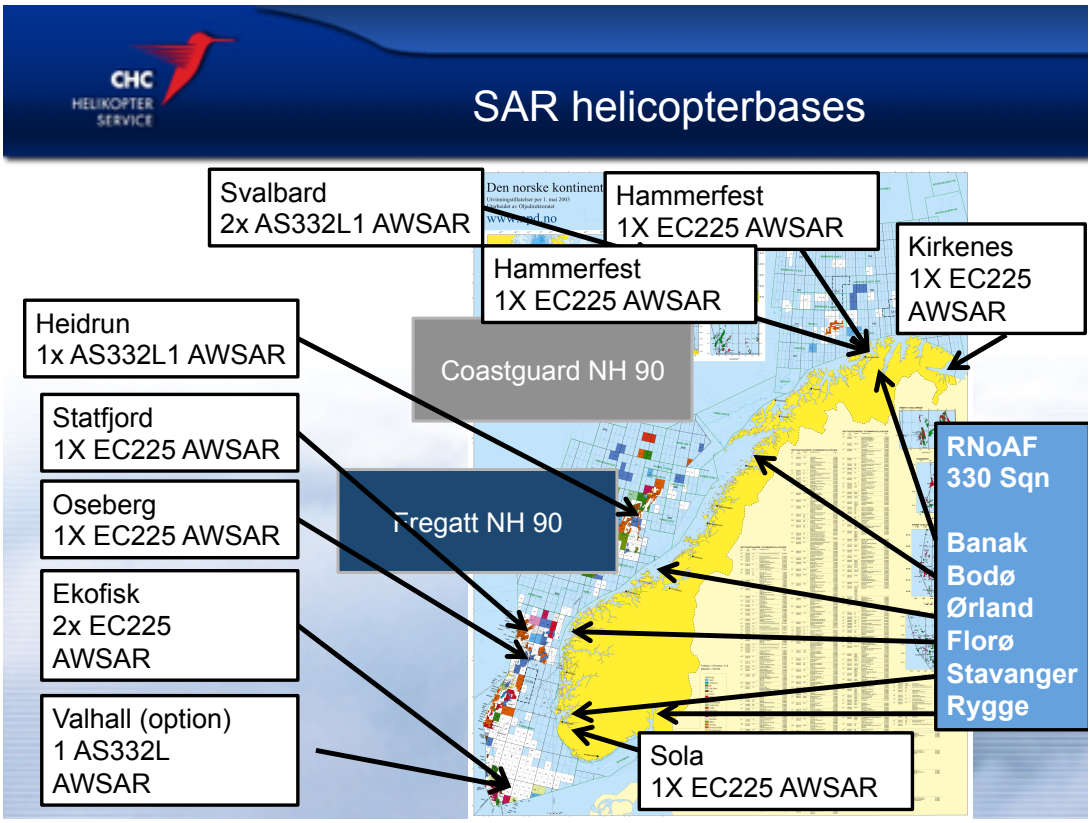


Figure 2: Number of Norwegian search and rescue helicopters by 2016 (Illustration by courtesy of CHC Helicopter Service).

The need for such procedures for the coordination of aerial SAR units, has its background from several maritime ship disasters. After the devastating fire onboard Scandinavian Star on the 7th of April 1989, leaving 159 people dead, Swedish SAR personell started to develop some procedures in order to improve the effectiveness and entry of several aerial units into the same SAR-scenario. However, these efforts did not result in the manual that are being used in the Baltic Sea today. Procedures were furthermore developed by Finnish SAR officials after another ferry-disaster, the capsize of *MS Estonia* between Stockholm (Sweden) and Tallinn (Estonia) on the 28th of September 1994, which left 852 people dead. One of the findings in the report after this cathastrophy, was that the helicopters wasted valuable time as they repeatedly searched the same empty rescue fleets for survivors

(Final Report MS Estonia disaster, 1997). The same report concludes that (translated from Swedish):

"In these types of large scale aerial efforts it is crucial that the On Scene Coordinator is supported by personell experienced in air traffic control". (Final Report MS Estonia disaster, 1997, p. 210)

Approximately eight hours after the MAYDAY-call from *MS Estonia*, a total of 19 helicopters from Finland, Sweden, Estonia and Denmark were directly involved in the SAR operation. The same amount of surface vessels were involved. 104 survivors were rescued by helicopters, 34 by surface vessels (The Joint Accident Investigation Commision, 1997). The coordination of the helicopters included important decisions concerning where to evacuate the survivors, where to refuel, which areas to search in, and whether to also start picking up dead people from the water. All of these decisions had an impact on the effectiveness of the rescue operation, and also on the safety of the helicopter crew. Clearly there is a need for aircraft coordination in large scale SAR operations.

1.2 Purpose of this paper

The entry of specific and new ACO-procedures into the norwegian SAR-service is initiated by the JRCC (Letter of invitation - ACO-meeting, 2011). Although the procedures have been tested in sporadic exercises, little *research* has been done as to how this might affect large scale rescue operations. The goal of this essay is to explore the possible positive and/or negative effects of this implementation of new procedures. And also to look into how, and by whom, the tasks of and aircraft coordinator may be performed in Norway. A key subject will be to try to define what role an aircraft coordinator will have in mass rescue operations in the High North. The vast distances, the lack of refueling alternatives, the communicational barriers and the climate challenges in the arctic part of Norways search an rescue region (SRR), and how this will affect the ACO-role, will be discussed. Educational and possible competence strategies related to the implementation will also be analyzed and commented on. The discussion of the ACO-roles potential will first and foremost be seen in relation to large scale operations involving multiple aerial units, both in the form of mass rescue/evacuation and search-operations at sea in the High North.

As this (in the Norwegian SAR-service at least) is a field that is being developed and implemented, the purpose of this study will include to identify present-time lack of competence, education and training in relation to the ACO-role. But also to point out the

possible path for this field to become operational with adequate training performed and exercises being held.

The purpose of an aircraft coordinator is according to the International Maritime Rescue Federation;

"...to coordinate the involvement of multiple aircraft in a SAR operation, in order to increase mission effectiveness, while maintaining flight safety for all aircraft involved. " (Jardine-Smith, 2015)

This paper will hopefully in some ways have a similar effect on both mission effectiveness and flight safety, by highlighting the possible improvement areas as to how the ACO-role needs to be performed within the Norwegian SAR sevice. By pointing out these areas, future exercises and missions might further challenge the effects of an assigned aerial unit coordinator, and thereby enhance and strengthen the operative performance of aerial search and rescue units (SRUs) in large scale SAR operations in the High North.

1.3 Problem in focus

The overall problem studied will be the coordination of several aerial units in mass rescue operations in the High North. The role of the ACO as a means of this will be in focus.

My main focus will be to study how the implementation of the formal ACO-procedures into the Norwegian SAR service may strengthen the operative performance in large scale search and rescue operations in Arctic sea areas. This is therefore my main research question:

How will a formal implementation of new ACO procedures into the Norwegian SAR service lead to increased operative performance from, and enhanced flight safety for, the aerial search and rescue units involved in a large scale search and rescue operation in the High North?

The term *"..a formal implementation..",* is here to be considered as the process following the new IAMSAR-manual being released this year (2016). Norway is obliged by its membership in both the International Maritime Organization (IMO) and the International Civil Aviation Organization (ICAO) to follow this manual. As it contains new ACO procedures, there will in fact be formal demands put upon the Norwegian SAR system by this release.

The *"..Norwegian SAR service"* will be described in more detail in chapter two, but in this context it is considered to contain the part of the system that is being triggered by the JRCCs in a (large scale) SAR-operation at sea. I.e. ships (often Coast Guard vessels), SAR-helicopters and airplanes.

"Operative performance" can be defined as; *"...performance measured against standards or prescribed indicators of effectiveness and efficiency…"* (businessdictionary.com) Organizations and units involved in SAR, military squadrons and other agencies in aviation is in almost any way dependent on standardisation as a measurement for their performance. In this paper operative performance is related to effectiveness, efficiency and safety as explained in the following.

"Efficiency" can sometimes be confused with *"effect"* (which is more or less purely focused on achieving a goal). However, *efficiency* also has to do with the process, the effort and the time spend achieving this goal (diffen.com). Amongst people in the SAR-system one often hear the term *"best practice"*. Hence the efficiency of the use of participating units and agencies will be discussed in relation to the effect they will have in the end. The reason being that the interesting perspectives and possible improvements of a SAR-system lies in many ways in the different processes taking place. But the operational effect (result, achieving the goal) will also (in the end) have to be held as a central dependent variable.

"Flight safety" is a somewhat wide term containing different aspects. Depending on who you ask in the aviation world, one might have very different opinions on the term. But in relation to this paper, it will discuss the safety of SAR units (SRUs) in relation to other SRUs being involved in the same SAR operation. And in many aspects the ACOs influence on certain safety aspects, e.g arranging refueling stations and relaying weather reports. Safety can in this aspect be seen as one goal of effectiveness.

As mentioned, the wanted end result of an introduction of more specific ACO-procedures will have to be some sort of operational effect. If not, it is hard to see why one would introduce procedures that in some ways also will complicate the coordination of aerial SAR assets. I will get back to this in my overall *analytical model* further down.

One very simplified slogan that is presented in an ACO-course being held in Denmark by their Navy and JRCC is; "*safety first, and efficiency will quickly follow"*. My interpretation of why the word chosen is "*efficiency"* and not *"effect",* is that these ACO-procedures are designed to minimize time spent over a vessel in distress (e.g. by a SAR-helicopter), in order

to maximize the effect (e.g. hoisting large numbers of people) by multiple SRUs. So the process has to be *efficient* in order to have the wanted *effect*. But if the safety aspect is overdone in the process, the quite opposite might actually be the result. Therefore it will be interesting to challenge this slogan with the many times harse conditions of the High North. It may by many be considered unsafe in itself to operate aerial SAR-units over long distances and far away from refueling stations. Inadequate weather services in the Arctic adds to this picture (Civil Aviation Authority Norway, 2015). As a result one could claim that a safe coordination of aerial units under such circumstances is not possible. But there is almost always risk involved, and if the risk is calculated, it may be acceptabel and even possible to reduce. SAR missions in the High North is no different in this aspect. Therefore a more sound and useful approach to this question is to try to study and foresee how operation in the Arctic regions will affect the possible effects of the ACO-role. Hence the formulation of a divided sub-thesis:

How will the context of the High North affect the ACO-role with regards to;

a) procedures,
and;
b) improvisation.

For precision purposes, the question and its different terms requires some explanation. The ”High North” term was introduced by Norwegian officials as the English synonym for the Norwegian term ”*nordområdene”* (i.e. the northern areas) already in the mid 1980s, but has only since 2003 frequently been referred to in official Norwegian governmental documents. Mostly in relation to political strategy. It is not a clearly defined geographical area (Skagestad, 2010), although Norwegian authorities in 2006 did issue a loose geographical definition stating that the High North;

”...covers the sea and land, including islands and archipelagos, stretching northwards from the southern boundary of Nordland county in Norway and eastwards from the Greenland Sea to the Barents Sea and the Pechora Sea” (Norwegian Ministry of Foreign Affairs, 2006:13)

Interestingly enough the islands of Svalbard is not explicitly mentioned in this definition. Thereby maybe underlining the political aspect of the term. The term *the Arctic* does have a defined geographical extent, but in various ways depending on perspective. From

being the part of the earth north of the even line of the Arctic Circle (north of 66 degrees 33 minutes northern latitude), to the more specific definitions of *north of the forests* (the tree line) or north of the *+10 degree July median temperature.* Although Støre (2012), claims that the Arctic and the High North terms are internationally used interchangeably in most aspects, Skagestad (2014) claims that the expression High North is uniquely a Norwegian phenomenon, and is not internationally self-explanatory in any way. Even if there is no clear definition of the High North, this paper will refer to it as the area well north of the Arctic Circle, but seen in relation to the Norwegian search and rescue region (SRR) including Svalbard and extending to the North Pole. The following picture (degraded) illustrates the central area of my thesis, derived from the Common Operational Picture (COP) at the Norwegian Joint Headquarters. The mapping is not to scale as the projection overemphasizes the islands of Svalbard compared to mainland Norway.

Figure 3: The area of discussion in relation to this thesis. In blue (two-thirds down the picture) the NoCG ship KV Svalbard typically positioned around Bear Island, midway between mainland Norway and Spitsbergen. PS! The name "Stockholm" appearing between the island of Spitsbergen and White Island is in this case a shipname. (Degraded picture, by courtesy of NJHQ).

Although the SAR-cooperation between the Arctic Council memberstates, and also the bilateral SAR-cooperation between Norway and Russia will be discussed in some ways, my use of the Arctic term will first and foremost cover the aspect of climatical conditions of the High North. The distances between infrastructure and settlement gives this perspective an extra dimension.

The term ”*improvisation”* is to be seen in relation to competence as a basis for the ability to ”responsible” improvisation in SAR-operations. The lack of communication, runways, refueling stations, wheather forecast and other imperative needs for aviators in the High North, will put some restraints on performance in respect of the need for increased margins, and thereby less time on-station. Improvisation will throughout the paper be seen as a mean to overcome some of these challenges, without compromising the safety of participating aerial units. A theoretical perspective on improvisation is included in the chapter on theory.

The term *ACO-role* is already described, and will be further throughout the paper.

Another interesting aspect of the implementation of ACO-procedures (in Norway) is how this in reality will be coped with by the responsible authorities. A formal accept of these procedures, without having a thorough plan for how these procedures can be operationalized, is not going to result in neither the best possible efficiency, nor the best effect. In order to operationalize, education will have to be adressed. Training and exercise will be of utmost importance if this field is going to become a sustainable part of Norwegian SAR-service. These aspects lead to a second sub-thesis.

How will new and more specific ACO-procedures affect the need for formal education, training and exercise?

It may be relevant to insinuate that there is a ”competence gap” to close before these new procedures can be seen as fully integrated into the norwegian SAR-system. In 2011 JRCC South (at Sola, Stavanger) sent out an invitation to meet different departments and military units, whom they considered suitable as an ACO in accordance with the new Baltic ACO-procedures (Letter of invitation - ACO-meeting, 2011). Since then there have been a few exercises where the ACO-concept have been tested. Administratively on the other hand, there has been little progress. This according to the official who issued the invitation on behalf of JRCC South (Conversation with JRCC official, 2016).

The term *ACO-procedures* will be thoroughly described throughout the paper.

Together with questions as to how the Norwegian SAR-service will be able to cooperate and coordinate with natural partners in the High North, several more sub-questions might be in need of discussion. But as the aim of this paper is to explore what the implementation of new ACO-procedures will contribute with in terms of *operative performance* and *how* this implementation can be successfully achieved, the following analytical model describes the main and sub-theses:

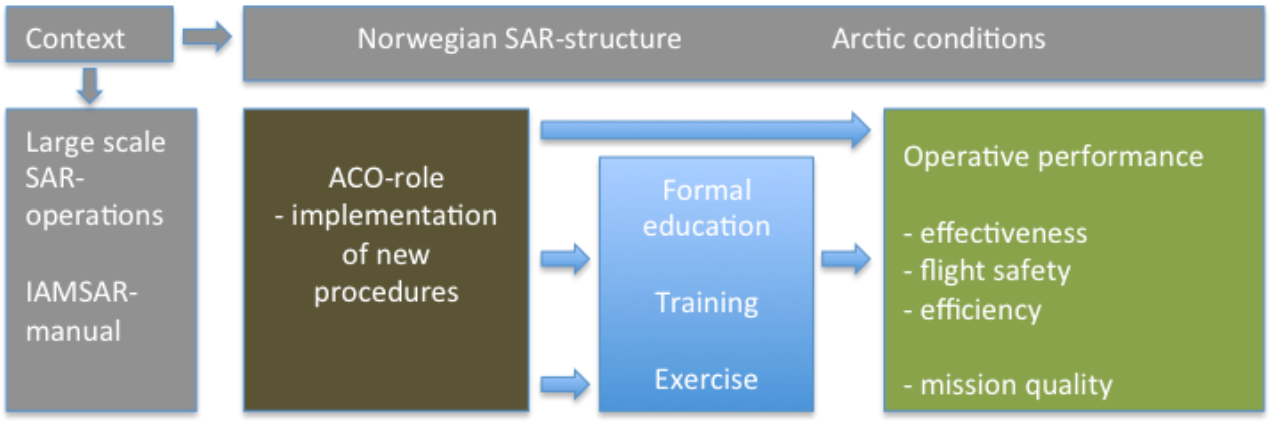


Figure 4: Analytical model with context, main and sub-theses relationships. Independent contextual variables in grey, the central and intermediate variable in brown, independent competence variables in blue, and the dependent variable and possible effects in green.

The contextual dimensions of the model; the Norwegian SAR-system, Arctic conditions, large scale SAR-operations (e.g. Mass Rescue Operations (MRO)) and the IAMSAR-manual, form a set framework for the more practical part of the research. On the receiving end of the model, so to speek, is the dependant variable, *operative performance.* Under the ACO-regime, operative performance consists of respectively *operational effectiveness, efficiency* and *flight safety* for the SRUs involved in an operation. But in order to get there, the main- and sub-theses independent variables of *formal implementation* and also *formal education* needed, will be examined. The ACO-role and the implementation of procedures, as according to the figure, will be the intermediate variable in these relationships. And therefore, the ACO-role and its contents, will serve as a mechanism for the effect of the independent contextual and educational variables, on the dependent variable of *operative performance*.

1.4 Exclusions and organization of the paper

This thesis will eventually focus on the ACO-role in large scale SAR operations *at sea* in the High North. The High North/Arctic context will be somewhat limited to roughly within the boundarys of the Norwegian SRR. Over land operations become more complex when taking into account terrain challenges that will complicate communication, navigation, weather (wind, turbulence) and so on. Experience in the form of exercises and incidents over land will be discussed and referred to, simply because the may be of great interest to the thesis, and also for the fact that there are (luckily) very few serious incidents at sea in the High North to refer to. For the sake of simplification however, operations over land is excluded when it comes to answering the research questions. Also for the fact that aircraft coordination becomes more imperative when operating over long distances, with less alternative landing sites, less refueling options and out of communication range. In the High North the most challenging scenario is perhaps a large cruise ship in distress far out to sea. Therefore operations at sea still becomes the more challenging scenario, often with less resources available within due time. Critical decisions must be taken at an earlier stage in order to take care of both the SAR-personells safety, and to be able to rescue the maximum amount of people in a minimum amount of time.

This study will in the following chapter focus on the main- and sub-thesis as seen from a theoretical point of view. Both through theory on situational awareness, decision-making, improvisation and high reliability organisations (HROs). The latter in connection to what is often called *"the Norwegian model"* (regarding SAR-service).

The methodology used will be discussed in chapter 3. With research design, data collection methods, data analysis, validation of data and ethical considerations as the main topics.

Chapter 4 is presenting the data collected in relation to variables and context, and chapter 5 contains analysis of the findings related to each research question. Both of these chapter must be seen as part of the analyzes, as an ever ongoing process.

Conclusions based on the findings of the study will be presented in chapter 6.

Chapter 7 wraps up practical implications and limitations related to the study. Recommendations for further studies is also the topic in this last chapter.

2 Theoretical framework for examining the ACO-role

The *role of the ACO* is as pictured in the analytical model, the central independent variable. And therefore the contents in, and demands put upon this role, needs a broad theoretical perspective. The goal being to analyze how this role can contribute to operative performance in SAR. Therefore human capacity the light of situation awareness, flexibility and decision making needs to be investigated.

There are some aspects of SAR-operations that will always be a challenge no matter what. The nature of a large scale incident is characterized by *uncertainty*. When a serious situation first occurs, it will trigger a massive (at least felt) need for information for all units involved. Not the least for the decision-makers and also at the operational level of the SAR-service. In this case the JRCC, but slao the person or unit appointed as ACO. Theory on decision-making will therefore be adressed to some extent.

Then there is the timeaspect. When peoples lives are at stake in high numbers, one does often not have the luxury of gathering all information needed (or *felt* needed) before taking action. This again means that assets must be activated at an early stage in order to actually have an impact on the situation. Once units are underway, the need for communication with these quickly arises. In the High North this is a challenge, and sometimes even made impossible by the lack of communication carriers. If this is the case, JRCC will sometimes have to rely entirely on the units own best judgment at the scene. Therefore a strict and authoritative organization may not be the best solution. On the contrary, delegating responsibility in the chain of operation, and being able to improvise by all elements involved, may be imperative to the successfull outcome of the situation. Complicating this picture is the possible contradiction between safety and efficiency. Too much safety may hamper efficiency and ultimately effectiveness.

In building a theoretical framework for this paper, my focus has been on theory that I consider necessary, in order to help the agencies and units involved to adress the previously mentioned issues.

Another interesting theoretical topic in relation to the management of multiple units in a complex SAR-incident is the capability to *improvise.* As no two SAR situations will be exactly the same, neither will specific procedures cover all eventualities. For the role of the ACO, this means that the ability to remain flexible might be very useful. Coupled with principles of so-called HROs (High Reliability Organizations), it provides a theoretical

backdrop onto which the complex and paramount task of coordinating aerial units in a complex SAR-structure such as the Norwegian, might be held.

What will not be discussed, and maybe missed by some, is organizational theory. This is left out because organization of SAR-units during a SAR mission in my opinion is more or less too complex to describe through ordinary organizational theory. It simply does not fit the classical organizational theory. What *is* an important and basic human element of any challenging situation, and the containment or mitigation of it, is *situation awareness.* But as a more overall approach to the Norwegian SAR system, theory on HROs will be presented at first.

2.1 Principles of high reliability organizations (HROs)

In this chapter I will focus on what characteristics high reliability organizations (HROs) possess, and then argue that these principles are preconditions for the ability to improvise at the very frontline in a critical situation, e.g. if a passenger plane makes an emergency landing in the polar bassin. Joint (air-sea-land) rescue coordination centres (JRCCs), like the ones that are the hubs of the Norwegian SAR service, are certaintly expected to act as HROs. And if the SAR system as a whole, all the way out to the frontline of operations, are able to adhere to the five principles of an HRO outlined in the book *"Managing the unexpected – resilient performance in an age of uncertainty"* by Karl E. Wieck and Kathleen M. Sutcliffe, then the ground for an efficient and safe execution of even large scale operations may have been prepared to some extent.

The first three principles they highlight are the ***principles of anticipation***. (Weick and Sutcliffe, 2007, p. 43)

HRO Principle 1: Preoccupation with failure

This principle points to findings that in order to achieve high reliability in an organization, a small failure in the system is treated as a potensially disastrous failure if several small failures coincide. Therefore a HRO encourage reporting of errors, and try to learn from their near-misses as well as from the ones that actually went wrong.

HRO principle 2: Reluctance to simplify

The world is in many ways complex, unstable and unpredictable. An HRO is according to Weick and Sutcliffe (2007:5) *reluctant to accept simplifications*. By doing so, the

organization might actually see recognition of a ”known” failure as something to be utterly sceptic about. This type of thinking enhances sceptisism toward received wisdom, and thereby creates a more detailed picture of a situation. Which again can encourage new wisdom to be achieved.

HRO principle 3: Sensitivity to operations

According to Weick and Sutcliffe, the frontline is the place where ”the real work” gets done. In a SAR-operation one can argue that this is in many ways true. What separates HROs from other organizations, is that they are very attentive to the front line, and tend to stay that way. ”*Their focus is less strategic and more situational.”* (Weick and Sutcliffe, 2007:12) This is certaintly true for the JRCCs operation rooms.

The next two principles are termed ***principles of containment.***

HRO principle 4: Commitment to resilience

The Norwegian SAR service is of course not a perfect system. The question is rather if they are able to continue to function during prolonged strenous effort. This is what this fourth principle is about. To keep functioning.

”The essence of resilience is therefore the intrinsic ability of an organization (system) to maintain and regain a dynamically stable state, which allows it to continue operations after a major mishap and/or in presence of a continous stress.” (Weick and Sutcliffe, 2007:14)

As an organization designed to cope with crisis, which sometimes can go on for days, it seems obvious that a SAR service has to satisfy such a criteria. On of the ways that this can be done is by adhering to the last of the main principles of an HRO.

HRO principle 5: Deference to expertise

HROs push decicion making down in the organization. This prevents errors at higher levels to spread downwards in the system. Instead it enables personell with the most expertice to take timely decisions at their level, based on the latest information available. This most certaintly seems like a logig objective for a SAR service, where the front line might be hundreds of miles away from the formal decion-makers at the JRCC. As an obvious example; the decision of which person to pick up first from the water, the one floating face-down or the one floating face-up, has to be taken by the ship- or helicopter-crew on-scene.

This last principle points to frontline operations (as does a couple of the others too). In a maybe rapidly changing scenario with many people in distress involved, it seems fair to assume that decision-makers also must remain dynamic with regards to what they base their decisions on.

2.2 Situation awareness (SA)

SA is a term readily used in aviation, and has its theoretical background from the study of how pilots gathered, sorted and processed great stores of information in their dynamic environment (Endsley and Garland, 2000). A large scale mass rescue incident will introduce huge demands for prosessing amounts of information for those involved in coordination of all the resources. Every crewmember onboard a SAR-asset will immediately have an association afilliated with the term SA. It can in simple words be described as *"...knowing what is going on around you"* (Endsley and Garland, 2000:5). Implicite in this is also the understanding of what is *important* to know. In relation to my paper, interestingly enough Endsley (2015:2) states:

"*That is, we come from a perspective that has always considered work in context and has always studied primarily experts performing their tasks within their real-world constraints, mainly for the purpose of improving that work from the standpoint of efficiency or safety."*

Performing the duties of an aircraft coordinator, in a demanding situation where peoples lives may rely on your ability to sort and process relevant information, falls right into this perspective on performing tasks within real-world constraints for the purpose of increased efficiency or safety. In fact, situation awareness is a necessity for anyone to perfom as an ACO. I will therefore in the following look into SA in a theoretical perspective.

Situational awareness in an individual perspective

Since the 1980s situation awareness has become a major area of study within human factors research (Endsley and Garland, 2000). As a pilot onboard an aircraft, you do not need to know everything. But you need to know what is important to you. The goal of safely flying the aircraft relies on it. A general definition of SA involves human processes of perception, comprehension and projection (Endsley and Garland, 2000). Shown in figure 7 are the three levels of situation awareness, how they relate to decision-making and performance of actions, and what individual and system factors that affects the SA-decision-performance cycle.

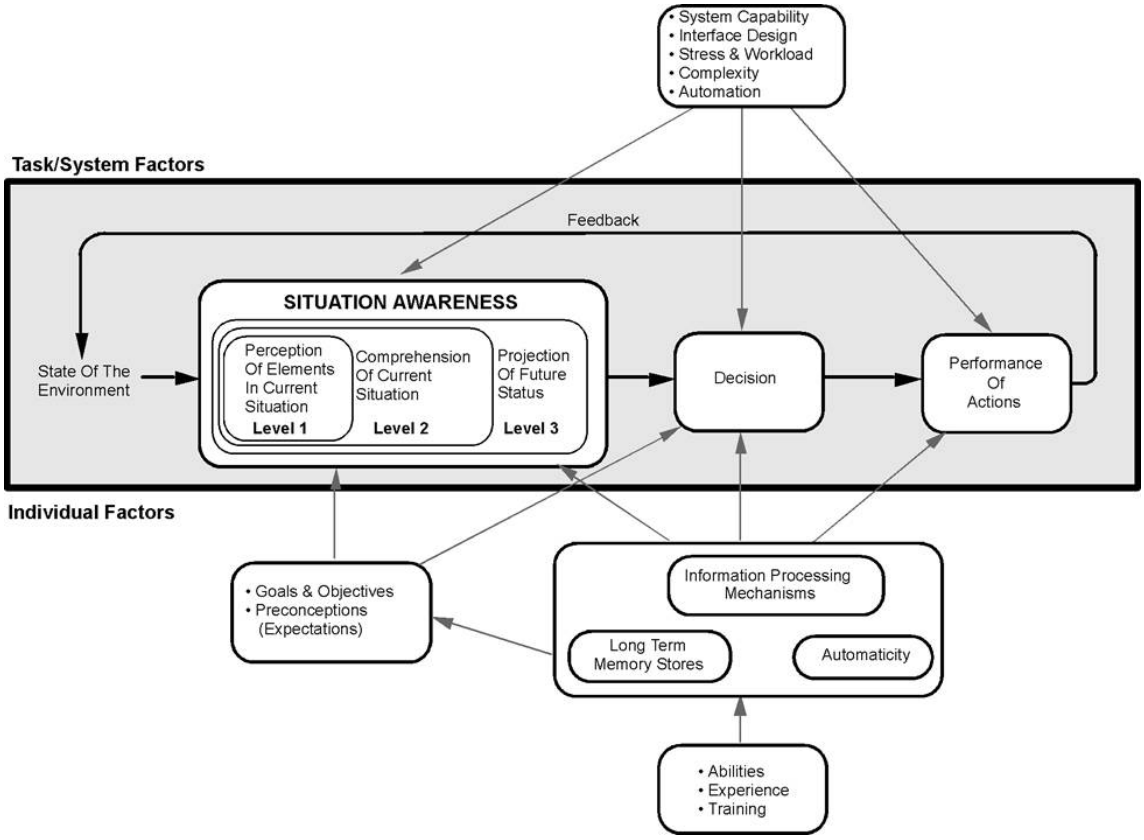


Figure 5: Model of situation awareness in dynamic decision making (Endsley and Garland, 2000).

Level 1 SA is the ***perception*** of fundamental and important information in any current situation. Without this level of SA achieved, it is impossible (or highly unlikely, unless by coincidence) to form a correct picture of the situation.

Level 2 SA encompasses ***comprehension***. The ability to combine and interpret the information achieved at level 1, and also store and retain that information, leads to this next level SA. Endsley and Garland (2000) describes this as a person able to derive operationally relevant meaning and significance from the data percieved at level 1.

Level 3 SA is the highest level of SA, discribed by ***projection***. This is the ability to project *from* current events and dynamics, and from there on *anticipate* future events and their implications. This is neccessary to allow for timely decision-making. Endsley and Garland (2000:7) state that: *"...experienced operators heavily rely on future projection. It is the mark of a skilled expert".*

Another important aspect of SA with relevance to an ACO-function, is the perception of both *time* and *space*. Coupled with the dynamic nature of a SAR situation, it is a critical part of SA in this context. The understanding of how much time is available until some event occurs or some action must be taken, is essential on an ACOs part. Again; the time-consuming distances of the Arctic makes this aspect even more relevant.

SA and *decision making* is, as the SA-model in figure 5 shows, clearly interrelated. It is of course possible (e.g. by pure luck) to make a good decision without necessary situation awareness. It is on the other hand also possible to have sufficient information and level 3 SA, and still make a decision that does *not* contribute to reaching the wanted goals or objectives for the action. But SA as a precursor to decision making is seen as a key factor in turning good SA into successful performance (Endsley and Garland, 2000).

Another interesting view on SA is the distinction between *incorrect SA* and *low SA*, in the meaning; being *wrong* versus being *uninformed* (Minotra and Burns, 2015). It may very well be of importance in the High North, where communication still is limited and hampered in many ways. Information from vast positions passed on to decision-makers may not be trustable on the shear basis of bad radio- or satellite-reception.

Thus SA in all its aspects will be of relevance to this paper. But as this in any aspect is a field of cooperation, ***Team SA*** will be of utmost importance.

Team SA – Shared, Distributed and Situated SA

The term *Team SA* has in the latter years been the subject of much research from different schools in the SA-field. Endsley (1995:38) defines team SA as;

"..the degree to which every team member possesses the SA required for his or her responsibilities".

According to Chiappe et al. (2012), Endsley view team SA, like individual SA, as a product and a type of knowledge, that is disconnected from the process in which it is aquired. The scientific discussion around team SA has to some extent evolved into a discussion between shared SA, Distributed SA (DSA) and Situated SA. Whilst Endsley (1995) stress shared SA, and argues that it can be seen as individual team members overlapping SA requirements, Salmon et al. (2010) questions whether SA can be shared at all. They claim that *information* may be shared, but the product (knowledge and understanding) derived from information, may not. Instead they uphold *Distributed SA* (DSA) as an answer to the dispute

around team SA. In their view DSA is acquired and maintained through *transactions in awareness* that arise from *communications* and *sharing of information*. As opposed to Endsleys view on ”sharing of SA as a whole”.

A third view on team SA is *Situated SA*. In short, Chiappe et al. (2012) claims that in this perspective individuals offload information to their environment whenever possible to minimize effortful internal processing.

Views on SA in relation to technology

Another interesting aspect of situation awareness in relation to my thesis is presented by Stanton (2010:3);

Despite the fact that technology undoubtedly lets us operate in inhospitable environments, Woods and Sarter argue that there is often the misplaced uncritical belief that technology is a situational awareness provider when, in fact, the opposite is often the case. Technology has fallen short on its promises many times, often resulting in increased complexity and confusion for human operators, ultimately contributing to breakdowns in system performance.

This points to one of the very often identified shortcomings in dynamic environments; lack of equipment and technology. Often technical equipment is viewed upon as the solution to the shortcomings. As viewed by Stanton, the remedy of more equipment may not always be the more efficient path.

SA in dynamic aviation environments

As previously commented on, research on SA has a tight coupling to aviation. The subject as a whole has in many ways been developed through; at first research on the single pilot, then on to multi-crew research resulting in e.g. theories on crew resource management (CRM). And lately also on to research regarding larger distributed teams. Rafferty et al. (2013) focused on friendly fire during close air support missions, and found that a tightly integrated set of information elements is a necessity in small co-located teams. As opposed to in larger distributed teams (such as e.g. a part of a SAR system), where everyone does not need to know everything. They lean on the main principle of DSA, as according to Stanton (2010) is that SA is a result of interaction between people and the world around them. Plant and Stanton (2016) showed that a particularly tight coupling exists between team members in the SAR context (onboard a SAR helicopter), and states that:

"The SAR team environment is highly standardised", and that *"rules and procedures are an important information source for developing a compatible understanding of the situation"* (Plant and Stanton, 2016:16).

Overall, the analysis of types of communication is consistent with Bourgeon et al.'s (2013) finding that aircrew communication is characterised by the sharing of information and the directing of actions. This supports Rafferty et al's. (2012) assertion that in small, co-located teams, there needs to be a tightly integrated set of information elements (i.e. tight coupling in the SAR crew network), whereas in larger distributed teams this is less important because everyone does not need to know everything (i.e. loose coupling in the all-agent network). In terms of DSA, it would be inappropriate and a waste of resources for everyone in a distributed team to know everything because of the diversity of roles within the all-agent team. For example, ATC do not need to know when the SAR crew speak to a Coast Guard ship. Instinctively, these thoughts on distributed team SA seem to be relevant to a team of SRUs heading out to sea in the vast areas of the High North. Stanton et al. (2010) warned that one of the disadvantages of distributed teams is that tightly coupled work, where individual tasks are highly dependent on the work of others, is more difficult. As certaintly may be the case in a mass rescue situation in the High North.

SA and links to decision making and performance

According to Endsleys model in figure 5, SA can be seen as a major input to, and the basis for, *decision making* itself. SA can even have an impact on the *process* of decision making (Endsley, 1995). Numerous studies from Manktelow and Jones (1987), showed a relation between situation parameters and peoples ability to apply an appropriate mental model, and from there on creating a problem-solving strategy.

In relation to *performance* it is in general believed that poor performance will occur when SA is poor, incomplete or inaccurate. But if an operator is *aware of* his or hers poor SA, this may lead to modified behaviour and thus preventing the poor performance. Endsley (1995:40) concludes that good SA may increase the possibility of good performance, but can not necessarily guarantee it.

A high degree of situation awareness is associated with good decisions, and vice versa for a low degree of SA. According to Johnsen (2005) SA is a critical factor for efficient functioning in dynamic environments, and closely related to decision-making and performance. Lack of situation awareness is in some studies identified as the cause of human

mistakes in critical decisions. Sneddon et al. (2006) reported that two thirds (67 %) of such mistakes in high risk professions could be traced to lack of level 1 SA. 20 % were caused by lack of understanding of the situation (level 2 SA) and only 13 % by lack of ability to project future implications (level 3 SA). So the ability to generate and hold a satisfactory SA is a crucial part in a decision process.

A widely used model in intuitiv decision-making is the ”Recognition primed decision-making” model (RPD). This form of decision-making is built on earlier experiences, and speeds up the decision-making process (Klein, 2010). This leads us to another important aspect of operative decision-making.

2.3 Decision-making and the need for information in a crisis

In almost any type of crisis, the aspect of time will be of utmost importance. Whether it is a sinking boat, or a company experiencing a mediatype crisis, time to contain the crisis will be limited. The pressure to take the *right* decision is another big stressor. Under such circumstances (over time) a contradiction between information at hand, and available solutions might develop. I.e.; with time more information might become available, but in the same time earlier possible solutions to the problem, might be outdated. In the way that the room for a certain measure to be taken is not there anymore. For example; water have entered a ship to the extent that there is no longer any change of preventing it sinking, whereas it could have been possible to prevent, had action been taken earlier in time.

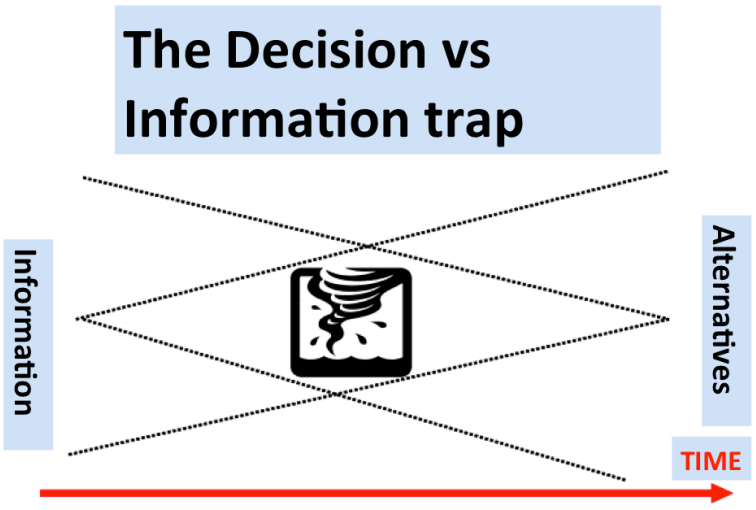


Figure 6: The ”decision-making vs information trap”.

Crossan (1998) describes this as the*"decision-making information trap"*. As a known phenomenon in psychologi, it can certaintly also apply to personell involved in SAR-operations. Pro-actively and moderately over-reacting in form of resources being scrambled, can be a necessary way to ensure that relevant measures are being taken early enough to contain a situation. On the other hand, in relation to a large scale SAR situation in the High North, the quite opposite may be necessary. An operator at the JRCC may have to hold back some assets initially, in order to later have resources available in the area. If as an example all SAR helicopter resources are scrambled at the same time, they may then all have to return to refuel at the approximate same time, leaving e.g. a distressed vessel without helicopter pick-up capacity for a sigificant amount of time. In the Exercise SkagEx 11 this was the case, and was afterwards illustrated by an interesting chart.

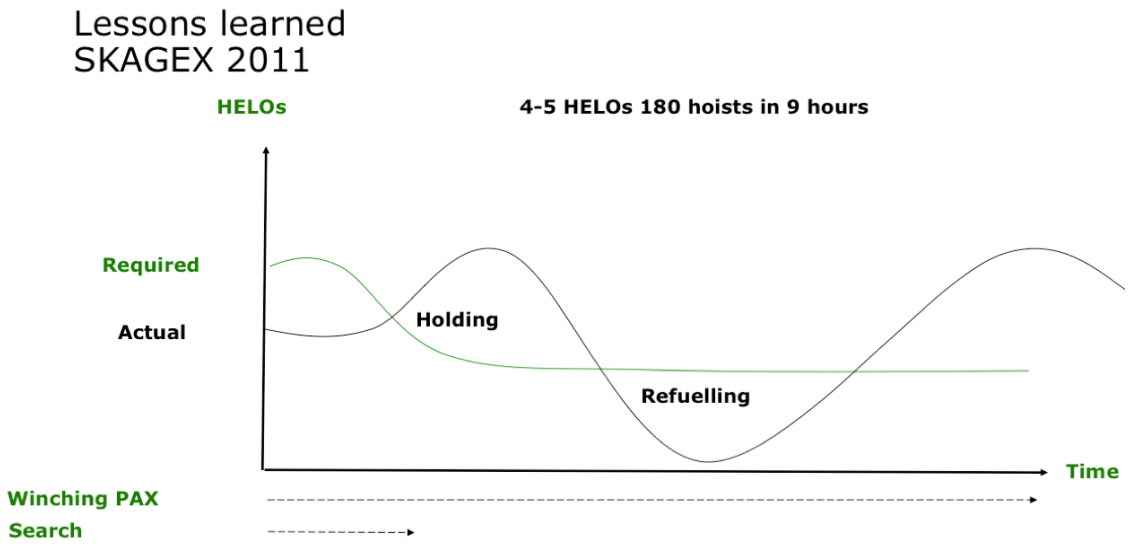


Figure 7: Chart showing the dilemma of scrambling all SRUs (actual) early in the incident, resulting in the lack of resources compared to what was required later in the incident. As experienced during SkagEx 11. (Chart by courtesy of Danish JRCC).

In the remoteness of the High North, with unsatisfactory communication and thereby below-optimum situation awareness, this dilemma potentially induce a serious challenge to decision-making on the behalf of the SAR mission coordinator (SMC) at JRCC.

2.4 Improvisation

Improvisation in itself is not a goal. But being able to improvise in challenging environments, e.g. in a ever changing mass rescue operation, might actually be the difference between life and death for people in distress. The theoretical term of *improvisation,* was originally derived

from jazz music, but has evolved as a managerial and later also a term related to readiness and crisis management. Many theorists argue that it can be seen as a combination of intuition, creativity, and bricolage (Leybourne, 2006). The term "bricolage" is originally a french term on how to make a creation with what is at hand, and make it emerge to something new (Sellerberg and Fangen, 2011). Dehlin (2008, p. 11) defines improvisation as *"...spontaneous and hermeneutical sense-making via external action"*.

Many of these terms, and maybe spontaneity in particular, may seem like a contradictive element of improvisation. At least in regards to aviation and aircraft coordination. In aviation in general (except perhaps from in a war theatre), spontaniety can seem like a quality not compatible with the tasks, often routine, that has to be performed. But, even though checklists are an important routine in aviation, there might be nothing routine-like about a large scale rescue operation. In that aspect the terms might actually contribute in a surprisingly adequat ways. Furthermore, Leybourne (2006) states that;

"*..intuitions are rapid and affectively charged judgements arrived at, without the apparent intrusion of rational thought"* (Leybourne, 2006:483).

Again, the thought of lack of rationality as a part of crisis handling can seem intriguing. However, no crises behave or unfold in a pre-planned way. With this in mind it is easier to comprehend the potential positive effect of spontaniety on performance in situations of crisis. In fact, it can be argued that improvisation is a necessity in an ever changing, ever challenging situation. And in some cases a tool that must be trusted. Crossan (1998:498) puts it this way.

"*Improvisation is one of the few concepts and tools we have to develop the capacity to be innovative in the moment."*

At the same time Crossan (1998) argues that improvisation requires some tolerance for error, and that different structures provide different tolerances. All of this might seem contradictory, but bearing in mind the latter part about different tolerances, one can relate this to crisis management. It is highly unlikely that errors will *not* occur during the handling of a crisis situation, but the *effect* of the error in such a situation, constitutes whether it is acceptable or not.

Mendonça et al. (2001) made the observation that emergency response organisations

(EROs) *must* be prepared to improvise during response activities, and that flexible approaches to emergency management are required. They look on the relationship between emergency response and improvisation, and comments that preparedness will not decrease the ability to improvise. On the contrary, they see preparedness as an enhancement for the ability to improvise. And thereby state that:

> *"…improvisation and preparedness go hand in hand."* (Mendonça et al., 2001:3)

They further make the observation that;

> *"…organizations need to maintain flexibility in order to respond to unanticipated contingencies."* (Mendonça et al., 2001:8)

In short they argue that organisations need to prepare for improvisation. The output being that this will enable them to revice (or rework) their knowledge of the current situation in time to fit the requirements. Kreps (1991) adds to the picture of preparedness being reliant on improvisation and vice versa, by stating that the flexibility of emergency management is in fact reliant on improvisation. And goes on to say that without preparedness, both efficiency and clarity in emergency management will be lost. So, the initially hinted anxiety regarding the relationship between aviation and such a "reckless" theoretical subject as improvisation, might find its salvation in the understandable *need for flexibility* in aviation.

Weick (1993) points to another controversy revolving around improvisation when he claims that teams, under certain conditions, may force their conception of the emergency to fit one they know how to address. This again tells that experience has more than one side. He further argues that one cannot expect creativity under life-threatening pressure. But in all, theorists and scientists seem to agree that in relation to preparedness, improvisation relies on both experience and expertise. Improvisation in itself has both its limitations and pitfalls when it comes to emergency handling. In the analyze section these theories will be discussed in regards to ACO duties.

3 Methodology and method

In designing a research, the question about whether to use qualitative or quantitative methodology early arises. Qualitative research is often used when we want to understand meanings, look at phenomenons, or describe and understand experience (Silverman, 2011).

According to Thagaard (2013) qualitative methods seeks in-depth understanding and emphasize *meaning*. While quantitative methods emphasize distribution and volume (or number). A normal aspect of qualitative research, is that it brings the researcher somewhat ”closer” to the informants. It is also in its nature *explorative* and driven by empiri, as opposed to quantitative research driven by theory and hypothesis (Tjora, 2012). The nature of this paper, and its specific thesis statement, to the qualitative method. But I did choose to also include some quantitative data that were collected in a ”moment of opportunity”. These data were used merely as background knowledge on my own behalf. Hence the methodology applied is qualitative.

3.1 Research design

A *quantitative* approach to the thesis in question could have provided a retrospective understanding of *how often* ACO-procedures have had to be put into play by the JRCC, but it would not answer questions on e.g. *how this might affect* the operative performance of SAR-units. For this to be exposed, one needs to dig into the material beyond numbers and statistics. As my research questions lie in a relatively narrow field of expertise, my approach would rely on me being able to *describe* the phenomenon in question. Hence a *descriptive* research design. This again meant that I would need to *understand* this field. By trying to do so, this would probably force me to change my views on the thesis in question during the research process (Palgrave, 2016). This flexibility can also be seen as one characteristic of qualitative design (Thagaard, 2013). Many books on the subjekt describe the qualitative process as going ”back and forth” during the research (e.g Tjora (2012)). Collected data might introduce new perspectives that will need more data to be collected and so on. He also argues that in many cases a *combination* of qualitative and quantitative approach will be favourable. And adds; ”*..if one have the resources to do so*” (Tjora, 2012:18). Time will often be the resource at stake for a researcher, so also in my case. My ambitions in regards both to *whom* I was able to include as interviewees, and *how* I was able to conduct these interviews, would be modified

during the process. And the intended mixing of both qualitative and quantitative methods was also altered somewhat during the process.

Even so, I did to some degree try to include a quantitative approach early in the data collection process. This both in order to gain more knowledge about the field of study, and also to help me to go deeper into the material further down the road. But the main reason was that I had a good *opportunity* to do a survey. I could simply not resist this opportunity, as I will explain later. As many uphold, having an interest for the field you are about to study, is the most important success factor. So this touch of quantitativeness came from a sincere interest in the field.

The fact that these new procedures were not formally implemented in the norwegian SAR system when I started my research, led me to the belief that I would have to base my paper on a broader qualitative empiri, than just in-depth interviews. My expectations were that the particular topic of ACO-procedures were lesser known amongst Norwegian SAR-personell than it actually proved to be. On the positive side, this meant that I spent a lot of effort understanding the topic myself, and thereby I believe I was able to go deeper into the matter.

An *inductive* approach, going from empiri (or data) to theory, could be uphold as a mark of qualitativeness. But the deductive perspective, e.g using theory to explain a specific event, can also be connected with a qualitative research design. As described, both the development in the field and my own personal understanding of the topic during my time of research, resulted in a process of repetitiveness. Research questions were changed because of data collected, and questions to interviewees were changed and added as a result of gained insight. In some ways I ended up using what Tjora (2012) calls a *stepwise deduction inductive (SDI)* method. Going inductively from data towards theory, and deductively checking theory against empiri along the way. Still, I would argue that my process was more of an inductive one, than deductive.

Known theoretical perspectives (e.g. theory on situation awareness) did play a role both as a background for my understanding and as an influence on the questioning in the interviews. While *grounded theory* (Glaser and Strauss, 1967) upholds an approach free of experience and theory derived purely from empiri, a more *hermeneutical* approach is one that is; ”*…concerned with interpretation”* (Silverman, 2013:445). In writing a paper based on experience, this hermeneutical approach seems more applicable. In fact; I would argue that

my approach has to be regarded as *double hermeneutical*. My interpretations of e.g. data collected from interviews, are *"...interpretations of a reality that has already been interpreted by those who participate in the same reality*" (Thagaard, 2013:42). Olsvik (2013) talks about a type of *experience based hermeneutics*. I find this expression intuitively to an appropriate description of my research.

3.2 Data collection methods

Silverman (2013:445) states that the development in qualitative approaches (with regards to research design) is characterized by diversity and variation. Thagaard (2013) lists four categories of qualitative methods: observation, interview, textual analysis and audiovisual analyses. I planned to use two of these (interview, textual analysis), but ended up having the opportunity to use all four of them. This posed some challenges timewise, but also gave the paper a broader base of data to rely on, and made the process of analysation very interesting.

Semistructured in-depth interviews with relevant personell

Since my topic circles around a set of procedures just recent formally introduced into the Norwegian SAR service, I realized I would have to identify relevant personell with knowledge of the topic. At the time of starting my research, only a few from both JRCC, the SAR helicopter community (military and civilian) and the Coast Guard (heliopter control officers) had participated at ACO-courses. Since then it is decided that all JRCC personell are to undergo the course, and many were educated during my period of research. JRCC are the ones responsible for the activation of ACO-procedures if an incident occurs. Therefore the number of possibly relevant informants in the Norwegian SAR service have grown during my time of research. This development meant that I soon saw both the need for, and opportunity to, more and updated data or empiri. As more people were educated, and the subject became a "hotter topic" (which may be only my feeling) during my period of research, I discovered more and more interesting informants. One interview could lead to another, so to speak. Even so, a strategic sample would have to be identified. With the thesis lying in a specific field of expertise, and the fact that I had the opportunity to do a mail-survey associated with Exercise NORD 16 as well, my conclusion was that my sample of seven relevant interviewees were plenty. But in order to understand all the different levels and functions within the service, this sample would have to consist of personell from both JRCC, the SAR helicopter community, ACO-candidates from the 333 Squadron (Orion P3 Maritime patrol aircraft (MPA) and the Coast Guard (CG). I started by interviewing two helicopter control officers (HCOs) from the

CG with experience and education on ACO, early in the process. A third interview of a person with a more peripheral function in the Navy, with regards to ACO-procedures, were rejected as irrelevant. This person did not have a good understanding of the concept, which she also informed me of beforehand. The interview where therefore shortened in time due to the fact that the shortcoming in knowledge became clear early in the interview session. As Silverman (2011:42-43) points out, effectiveness is important, and unnecessary use of an informants time and effort is to be avoided. I also did semi-structured face-to-face in-depth interviews of both Danish and Norwegian JRCC personell, as well as ACO candidates from aerial units and other-than-ship platforms. Most of the interviews were recorded, and deleted once transcribed. Two interviews with JRCC personell were written down by hand, as they were not happy with the recorder (my phone). In between the questions, I was given a demonstration of different data programming, and some of these programs were not degradable.

As mentioned, my own knowledge in the field greatly increased during my research. This influenced ”everything” in the process. Both the interview-guide(s), the strategic sample of informants and the research questions were numerous times developed and changed. Based on new knowledge and insight in the topic at question.

Being military, I deliberately dressed in civilian clothing during the interviews. I was afraid I would be regarded more of an ”expert” if I wore uniform, and thereby would miss some aspects from my informants. My feeling was that being dressed as a student, made it easier for me to step out of the ”expert”-role. The exception was interviewing the Danish JRCC-employee, where the military participants wore uniform during the course.

The design of the interview-guide was based on the research-questions, and as these were developed and changed somewhat, so were the interview guide. From early on being focused on the educational system when interviewing , the focus changed more over to operational aspects and the ACO-role itself. Due to this I also did a follow-up interview of the two HCOs first interviewed.

Participant observation

Observation is a form of qualitative research method that traditionally and typically have been linked to social anthropology. Today there are, according to Tjora (2012:44-45), signs that observation has had a (very much welcomed, according to Tjora) awakening also in social research. He illustrates the difference between observation, and the more widely used

interview-method, as studies of *what people do* as opposed to *what they say they do.* And concludes that if you are interested in what people do, one *should* include observation as method of collecting data. He further points to that observation as a method could be chosen simply because one has access to this form of datacollection. And that in many cases this will produce data supplementary to data collected by interview (Tjora, 2012:46-47). For me, this was exactly the case.

After having started writing this paper, I participated in an initial exercise planning conference on behalf of my unit. This exercise turned out already to be planned as a maritime search and rescue scenario, with participation from several aerial units. The JRCC-representative at the same meeting made a remark about this leading to a need for an Aircraft Coordinator, as well as an On Scene Coordinator. Being a military aviation representative, and also writing a paper on the ACO, I was asked to function as an ”aerial controller” during the exercise. This meant I would be part of the group planning the exercise. And, on the day of the exercise, responsible for the progression in the exercise according to the planned activity. I found this to provide a unique opportunity to observe the ACO-role performed in a complex SAR-scenario. Sellerberg and Fangen (2011) states that when using participant observation one can choose to act strictly as an observer, but this will make it hard to understand the communication and ”internal coding” within the group you want to observe. Or one can ”go native” and ”become one of them”. This can give direct experience, which again will lead to better understanding on the subject. I ended up somewhere inbetween these two alternatives.

My position on the day of the exercise would be onboard the NoCG vessel *KV Senja*, where personell acted as both On Scene- and Aircraft Coordinator. This proved very valuable to my paper, as it gave me unique data by observation. The same exercise gave me access to audiofiles, situation reports and SAR-logs from both JRCC and the CG vessel. Immediately after the exercise a so-called hot wash-up was held, also providing valuable data. The evaluation of, and discussion around the exercise in the following days, also gave me important perspectives.

But all this also introduced some ethical concerns, as my participation as both an exercise planner, controller and observer/researcher needed to be adressed properly. And this it will under the chapter on validity.

Audio-files

As mentioned in the previous chapter, participating in the Exercise NORD 16 gave me access to audio-files on the communication between the ACO and the SRUs. I listened through the files to decide whether these were useful data, in light of my research questions. They proved to be very interesting, and made to a great extent up for my split attention as both an observer and a controller during the exercise. The presentation of these interesting and also fun-to-work-with data, have been given its own extract in the data-chapter.

Document studies – IAMSAR-manual, incident reports, books etc

In document studies, it is important to be aware of a few central qualities of a document or report. E.g.; who has written or produced the document? By whom is it meant to be read? And last but not least; what is the purpose of the document? Most importantly there must be a close connection between the documents being analyzed, and the research problem in question (Tjora, 2012:15).

In this paper, I will argue, the reports, documents, books and evaluations being analyzed, lie close to the problems and thesis in question. In relation to the two cases of *MS Scandinavian Star* and *MS Estonia*, the mandate of the reporting commitees are very well documented. The purpose of the reports are official, transparent and also in more than one way in line with the purpose of this paper; a strengthening of the search and rescue service. As accident-reports, the main purpose will be split between giving answers to what happened, and to present an opportunity to improve in those areas that proved fatal.

In the third case (*Maksim Gorkiy*), I will refer to a book written by a member of the rescue operation. In this case the purpose is not in any way more doubtful. But the document (book) will of course be colored by the fact that it is written by one of the officers on the NoCGV *Senja*, that played a crucial part in preventing this being another large passenger ship catastrophy. This puts a higher demand on the researcher, as such a book in comparison to an official report, narurally will be more subjective in its form, and must be referred to with that in mind.

I was fortunate enough to receive a copy of the draft for the new IAMSAR manual in effect 1 July 2016, from a Danish JRCC representative already at the ACO course. Later on a I got an updated version of this draft from Norewegian JRCC personell. International standards, agreements and manuals are important SAR-documents which I will refer to and describe in the data-chapter.

Survey amongst fellow course participants

As previously mentioned, I got the chance to distribute a survey amongst a novise (when it came to ACO-procedures) group of people attending an ACO-course. This was a group consisting of 20 people with a mixed background both in nation and function/level within different SAR-organizations. I realized that trying to perform in-depth interviews during our one-week course together, probably would leave more questionmarks than answers. This due to the fact that all of us attending the course came with little knowledge beforehand of the procedures we were about to learn. But nevertheless I felt it might give me an overview of the knowledge on these procedures amongst nations Norway might directly cooperate with in a real case. Since we were located in a classroom, it was easy to get all respondents to answer. The reliability and validity of such a survey, with a random sample of 20 persons, is debatable. But performing a survey on them I felt would give me a hint on several aspects, amongst them how often they had had any experience with ACO-procedures in practical use. Compared to what professional functions they had, and if their country had formally approved the procedures, this gave a few interesting perspectives. As I gained knowledge in the field (the survey was done during the ACO course early in my research process), I realized that the questioning was, not irrelevant, but a little *immature* in regards to the subject, and I therefore ended up not analyzing only a few of the questions. The results are presented in the data-chapter, and the survey itself as appendix 2.

E-mail interviewing following Exercise NORD 16

Following the exercise I e-mailed a set of questions to the commanders of the SRUs and the persons acting as ACO. These questions were held back on purpose a few days, to create some distance in time from the points made in the hot wash-up. As expected, these written evaluations from individuals, created some very interesting points that had not been brought up during the hot wash-up all-in-one room session. I was positively surprised by the ”full-bodied” answers I got. It may very well be that my position as a part of the planning team and as an SRU pilot myself, influenced the respondents to answer to a greater extent than they would have if the researcher had been someone not part of the community. If so was the case, my professional background contributed in yet another positive way.

3.3 The analyzation method

As adressed under chapter *3.1 Research design*, the very well known *grounded theory,* focuses on theory purely based on empiri as an ideal. And as mentioned under the same

chapter, Tjora (2012) and his preferred SDI-method, can be descriptive of how the analyzation process in many ways went back and forth. From raw empirical data to e.g. transcription of interviews, and on to coding and categorisation. Since I used several different methods of gathering data, the analyzation methods of course also differentiated. As this process matured, so to speak, several of these steps in the SDI-method were altered in terms of method. In fact; both the transcription, the coding and the categorisation was modified somewhat.

Transcription

During the analysation process I realised that my understanding in the field had risen to such a level, that it would be a waste of time transcribing and coding all the interviews word for word, as I did in the beginning. Looking for deeper meanings and interpreting the interviewees answers ”between the lines” so to speak, felt artificial. Especially with the research questions being about something as concrete as procedures and effects. As opposed to more controversial or ethically difficult research questions, where people might feel they could not speak openly. The fact that I would conduct the interviews in Norwegian and the writing in English, also meant that these between-the-lines meanings probably would get lost in translation. My experience with the interview-situations was that this was a field of research that people easily spoke freely around, and that my knowledge in the field allowed my to transcribe through *”summarising important key points”* (Nilssen, 2012:46). This gave me timewise the opportunity to fully utilize the broad specter of methods I eventually got access to. And as such was a very conscious choice of mine in the end.

During the whole process of research and writing, the analyzing process was also somewhat constantly ongoing. Even possible conclusions were early noted. Some to be rejected later on, but some of these early assumptions also withstood the scrutinizing during the analyzation process. As Nilssen (2012) remarks, the analyzation is there from the start, and sticks with us during the whole process.

Coding and categorisation

The term and method of *open coding* was inspired by the grounded theory of Glaser and Strauss (1967). Tjora (2012) upholds the importance of staying close to the empirical material, and derive the codes more or less purely from this. I did at some point start to doubt this procedure. The procedures and technicality of my research questions, coupled with the expertise of my informants and respondents, had me looking for support for a more ”framed”

process of coding. This I found in the strategy of developing codes *a priori.* According to Sellerberg and Fangen (2011), this strategy builds upon some analythical frames. In my case my background and the specialized topic of research led me to some obvious (like situation awareness) and some exciting new (like improvisation) theoretical perspectives. In my data I soon found evidence for that starting ”all over again”, with coding derived exclusively from the text, would lead me away from my material. I therefore gave up on creating numerous different new codes for later categorisation, and started using my theoretical perspectives, variables and research questions as codes and categories almost combined. After all, both theoretical perspectives, variables and research questions had been altered based on empirical findings underway.

Furthermore I found that with all the different methods and samples of data applied, this would be the only way to get a grip on the material. Deriving different codes from logs, audio files, interviews, reports, e-mail-correspondance, observation and even a survey, would have left my sleepless for the duration of the research process. An example of the result of this method, in form of one of the interviews, is in appendix 3.

Audio files

The audio files from Exercise NORD 16 proved to be valuable and also very motivating. I received them from the Coast Guard on the same day of the exercise, and listened to them through my computer and a headset. They gave me access to examples of very interesting communication between the ACO and the SRUs. They also produced some quantitative data in the form of number of reports and dialogues made on different subjects, which will be presented in chapter 4.

Analyzation of the survey

I originally planned to use SPSS (originally Statistical Package for the Social Sciences) programming for analyzing the survey amongst participants of the ACO course. But as commented on earlier, I ended up using only a few questions of this survey, leaving the use of SPSS unnecessary complicated on this occation.

3.4 The quality of the data

My primary concern during the research process, in terms of quality of the data I collected, was my lack of distance to the subject. Both being a professional part of the Norwegian SAR system, and also having my own experiences within the system for almost 15 years, my objectivity can of course be questioned. But as Nilssen (2012:137) clearly states:

"...it is today recognized that this is an utopian thought. Qualitative research will always be influenced by the researchers background and pre-understanding".

In the extension of this, my choice of reseach questions lay in a field that have to some extent been neglected by the Norwegian SAR system so far. And therefore my insight into this specific topic also was limited at the start of the process. My background then could serve as a foundation for being able to analyse the subject at matter in a more profound manner. Tjora (2012:202) discribes the different criteria in regards to the quality of qualitative research, and although mentioning the criteria of *trustworthiness, confirmability and transferability,* being upheld by some as more suitable to qualitative research, he concludes that the criteria of *reliability, validity and generalizability* are more than adequat as quality criteria. I agree to this and will use these three criteria in discussing the quality of my data.

Reliability

As accounted for previously, I chose to view my knowledge and expertise as an advantage to my research. In fact I think it was a presumption for being able to analyze the field. But my lack of distance to both the topic and the SAR community posed a challenge during the whole process. Being part of both the SAR and the military system, I deliberately tried to avoid using persons that I knew beforehand as interviewees. But some of them I did have a pheriferal knowledge of, and some of the commanders of the SRUs participating in the exercise were known to me. In addition to this my role as both a part of the planning team, controller and observer in the Exercise NORD 16, was challenging. In having these different roles I would of course to a certain extent influence the participating group. But my overall feeling both during the exercise, and in the aftermaths, has been that this has not been a problem. During the execution of the exercise I was to a very small degree directly involved in the operations, but more so overlooking them. Most importantly my feeling was that as my thesis lies in a field of expertise, this made it easier for my to take out the necessary distance, so that personal and professional relations would not inflict to much in the research. All this discussed, made it even more important to be able to separate my own opinions from the informants opinions. In presenting the data I therefore use direct citation to a great extent, and in the end I am convinced that the conclusions are based on reliable data. As Nilssen (2012:137) states;

"In qualitative research the lack of distance is a strenght". (My translation).

Validity

According to Tjora (2012), the question on validity revolves around whether the answers we end up with in our research, actually answers the research questions we have formulated. In this he upholds that this again means that one must see the research questions in relation to different theories and perspectives, and also earlier research in the field. I did not find any previous research done in this specific field, but I did find several official and throrough reports on both exercises and real incendents on the matter, and these reports can in many respects be viewed upon as research, as they often are written or enunciated by scientists. Tjora (2012:207) criticizes the extensive use of in-depht interviews as a sign of weakness in the research with regards to validity. Having been able to utilize many different methods in gathering my data, this is not a critizism that I feel afflict my thesis. Being able to use several methods, I felt was a strenght to my ability to find valid answers to my research questions.

Generalizability

Depending on ones philosophical view on qualitative research, several criteria have been emphasized as more or less valid to this scientific direction (qualitative-research.net, 2005). The criteria of generalizability seems still to be considered important to qualitative research. Tjora (2012) refers to three different types of generalizability. *Naturalistic* generalizability relies on the reader to decide whether the findings are valid for his or her own research. *Moderate* generalizability relies on the researcher to describe in what situations the findings will be valid for generalization, and by *conceptual* generalizability is meant that based on research findings one can develop concepts or theories relevant to other cases or selections of studygroups (people). For this thesis the latter two, moderate and conceptual generalizability, seem more productive than the naturalistic view. In the sense that being in a specific field of expertise, I myself as a part of the professional system, may be qualified to point to what situations this research may be transferable to (as according to *moderate* generalizability).

In collecting the data I realized that to the specific scenario my thesis discuss (lareg scale SAR in the High North), most of my data dealt with less complicated scenarios. Whether it was exercises or actual incidents, they were in some ways simplifications of the described worst case scenario. Except from the large ferry-disasters mentioned and also the *Maksim Gorkiy*-incident. In the end I am confident that with all the data gathered, analyzed

and concluded upon, parts of this thesis will be relevant for the complete spectre of possible SAR incidents. And not only in the High North, as this is merely the context of the research.

Transparency and reflexivity

An important demand on research is that it is transparent. For something to be transparent it needs to be communicated. In regards to my research and this thesis, the extent to how ”honest” it is regarding the choices I have made during the research process and in writing this paper, becomes the norm on transparency. As an example my decision not to fully transcribe all the interviews was something I spent some time on deciding. Of course it had to be reflected in the reporting.

As empirical data can not in any way be a true reproduction of reality, it is also important that this aspect is reflected upon. My decoding and interpretation of the data has to be reflected upon *in itself,* so to speak. Hopefull I have been able adhere to both of these criteria, or *”indicators of quality”* as Tjora (2012:202) name them.

Ethical issues

Wording like *trust, confidensiality and respect* come into mind when thinking about ethics in science. In dealing and interacting with interviewees (informants) and respondents, these qualities will influence the quality of the data and thereby the whole process. To consider what stressors your own research has on your study group, may be very useful, also in relation to what quality of data you can acquire. Being informed and prepared to an interview, is a sign of respect to your informant. In my experience this increased the value of the answers (and thereby data), I received during the interviews. To me this shows that ethics and quality of data certaintly go hand in hand. I tried to attend to this in the best manner, and was rewarded with quality data, in my view.

Another important aspect is the approval from participants. As an example can be mentioned my use of the audio files from Exercise NORD 16. As mentined, observation was somewhat hampered by my function as controller in the exercise. Access to the audiofiles made to a great extent up for this. I was given written permission to use the audiofiles, and all the units were given a written explanation on how the files would be used, that the files would be deleted after being used, and that the dialog between the ACO and the SRUs would be anonymized. For the SRUs (being seven of them) it was possible to anonymize. But for the ACOs, being only one unit/two persons covering the role, this was difficult. The two persons serving as ACO were therefore explicitly asked for written approval of usage of the files,

which they did without seemingly any hesitation. And before the exercise the CG informed me that if an incident occured that in any way could lead to an investigation of any sort, I would not be given access to the audio files. The transparency in this process was important to me, and took some extra effort in the form of e-mail correspondance, but then again gave me a clear conscience and the right feeling on the matter.

4 Empiri in relation to variables and theory

At some point, the analyzation process goes into a final phase. These next two chapters will be the product of this final phase. Through coding and categorization, data gathered from the methods used (interview, observation, document studies, audiofiles, survey, e-mail-reponse) was assigned different labels. The data was then upheld towards theoretical perspectives, the different variables and the research questions.

In this particular chapter 4, the different *contexts and variables* in the analytical model, together with *theoretical perspectives,* will be adressed through empiri.

4.1 Organization of the Norwegian SAR service

The Norwegian SAR structure is a model developed over many years, and as an important contextual variable of mine, it deserves a thorough presentation. The Organizational Plan for the Search and Rescue Service (2015), describes the overall and formal organization of the Norwegian SAR system. The administrativ responsibilty lies with the Ministry of Justice and Public Security. Through two Joint Rescue Coordination Centres (JRCCs), one in the south of Norway (Stavanger) and one in the north (Bodø), all search and rescue at sea is coordinated. This includes searches for missing aircraft. Over land, rescue sub-centres (RSCs/police) are responsible. But in practicality, the JRCCs will be involved also inland, especially when it comes to the use of aircraft (in other than pure ambulance-missions, where the health services also have some dedicated resources). The JRCCs are in any respect supreme to the RSCs.

The framework for the Norwegian SAR response is made up of several *principles*:

The principle of cooperative organization

This principle states several important aspects. First of all that all relevant governmental, commercial and voluntary agencies are to be included in the SAR service on demand. Furthermore that all *governmental* agencies (the armed forces included), are obliged at *no cost* to contribute with all appropriate and available resources to a SAR operation (Ministry of Justice and Public Security and Ministry of Defence, 2015). Lately this principle has been expanded to also contain a understanding that all agencies have an *explicit responsibility* to ensure the best possible cooperation with other agencies before and during rescue operations.

The principle of responsibility

The agency normally responsible for a function or task on a daily basis, is also responsible in a rescue operation, no matter cause or extent of the operation.

The principle of an intregrated service

The same agency is to be responsible for sea-, air- and land rescue. Hence the *"Joint"* in JRCC.

The principle of coordination

Each JRCC is manned 24/7 by professional experts at SAR. They are to coordinate all preparations and efforts through the JRCCs and the RSCs. These rescue controllers have the authority to take all necessary measures, and assign all neccessary resources, to any lifethreatening SAR-incident.

In addition one could uphold that *voluntary work* is very much the basis for the Norwegian SAR service. The contributions from voluntary personell can not be overestimated in the norwegian model. But in relation to *this* thesis, the voluntary aspect is not relevant, as there will be purely professional assets taking part in a large scale SAR operation in the High North. This leads us on to another important characteristic of the Norwegian SAR structure (as a contextual variable), especially when it comes to Arctic waters.

CIMIC – civilian-military cooperation

A very noticeable part of the Norwegian SAR-system is the *military dimension*. The armed forces contribution to search and rescue is substantial. According to an official at the Joint Operations Centre of the Norwegian Joint Headquarter (NJHQ), its daily involvement and practical activity is:

> *"....70 % about contributions towards the civilian society"* (JOC/NJHQ, 2014).

As stated above, under the principle of cooperative organization, the armed forces are *obliged* to contribute in order to save human lives in a rescue operation. According to legal regulation the military´s contribution to the police when it comes to search and rescue, is excluded from formal and written preapprovement (Directive on the Military´s contribution to the Police, 2012:§2). In fact, the search and rescue helicopters of the 330 Squadron strategically based along the coast, are owned by the Ministry of Justice and Public Security, but operated by the Air Force under the Ministry of Defence (Organizational Plan for the Search and Rescue Service, 2015:§2-9). According to the same documents, and an agreement

between the same two minestries, the tactical command of the helicopters on alert 24/7 are delegated to the JRCCs.

The Coast Guard is the other of the armed forces dedicated contributor in the Norwegian SAR system offshore (in coastal waters and inland *all* of the military resources may be used in accordance with regulation). According to the The Coast Guard Act (1997:§14), SAR is one out of three shall-demands. The Coast Guard:

"...shall participate in, and perform search and rescue operations, when dangerous situations and accidents at sea occur". (Authors translation).

Hence, the civilan-military aspect is a very important, and for many years a well integrated part of, the Norwegian SAR system. The Ministry of Justice and Public Security (2012:79) has in a White Paper to the Storting on *Societal Safety* expressed the importance of the Militarys contribution to the SAR service:

"The Military is an important supplier of resources to the SAR service, and participate according to the principle of cooperative organization, in accidents and cathastrophies as necessary to save lives. Military helicopters and maritime patrol aircraft are important resources…. The Coast Guard is a significant stake holder due to its constant presence in the waters outside of mainland Norway." (Authors translation).

In another White Paper, this time specifically targeting the High North dimension, the Ministry of Foreign Affairs states that:

"The Armed Forces have an important role to play in terms of surveillance and intelligence, the exercise of sovereignty and authority, and incident and crisis management. The Norwegian model for civilian–military cooperation gives a better understanding of the situation and enhanced operational preparedness when dealing with cross-sectoral issues and ensuring civilian and military security. Maintaining a military and civilian presence, combined with appropriate capabilities and a good understanding of the situation, promotes stability and provides a good foundation for international cooperation in the region, including under the auspices of NATO. Our military presence is also essential for civilian purposes, in connection with preparedness and response, search and rescue, the environment, and access to information." (White Paper to Stortinget)

This quote takes in many facets of SAR in the High North/Arctic. Also in the distinction between foreign affairs and preparedness. SAR can be seen as a means of soft power, and

certaintly presence in the form of SAR-assets is a footprint in many aspects. As stated previously, I will not take on the more foreign affairs political side of SAR in the High North. But it is nevertheless an inevitable bi-product of SAR in the High North, and the aspect deserves mentioning.

4.2 Context - the Aircraft Coordinator in official UN documents

There are some central documents internationally, regulating SAR procedures in the sea and air domain.

At sea the 1974 *International Convention for the Safety Of Life At Sea* (SOLAS) and amendments thereafter, specifies minimum standards for the construction, equipment and operation of merchant ships, compatible with their safety. The 1982 *United Nations Convention on the Law of the Sea* (UNCLOS), states as follows:

" Every coastal State shall promote the establishment, operation and maintenance of an adequate and effective search and rescue service regarding safety on and over the sea and, where circumstances so require, by way of mutual regional arrangements cooperate with neighbouring States for this purpose" (UNCLOS, 1982:art. 98)

There was no international system covering search and rescue operations untill the 1979 *International Convention on Maritime Search and Rescue* (the SAR Convention), which aimed at developing an international SAR plan. The plan stated that the rescue of persons in distress at sea would be coordinated by a SAR organization and, when necessary, by cooperation between neighbouring SAR organizations. It put considerable obligations onto the parties (states), and were ratified by fewer countries than other treaties, untill a revised annex was adopted in 1998 and entered into force in 2000 (IMO.ORG, 2016). Amendments to this has been put in effect in both 2004 and 2007.

The 1944 *Convention on International Civil Aviation* (the Chicago convention) resulted in proposals for an *Annex 12 Search and Rescue* in 1946 already (ICAO.int, 2016).

This Annex 12 to the Chicago Convention, containing standards and recommended practices regarding SAR, has no specific mentioning of an ACO, but contains a very specific phrase on the RCCs responsibility when multiple facilities are engaged in SAR operations on-scene:

"...shall designate one or more units on-scene to coordinate all actions to help ensure the safety and effectiveness of air and surface operations..." (ICAO Annex 12, 2004:5-3).

Further the IMO and ICAO jointly developed the IAMSAR manual. This manual contains specific procedures for the ACO role, and is therefore also a contextual variable in my analytical model.

The IAMSAR manual

The IAMSAR manual is the key procedure document specifically on how to organize and provide for search and rescue services. As the product of a joint effort by both the International Maritime Organization (IMO) and the International Civil Aviation Organization (ICAO), its primary purpose originally was (and still is):

"...to assist States in meeting their own search and rescue needs, and the obligations they accepted under the Convention on International Civil Aviation, the International Convention on Maritime Search and Rescue and *the International Convention for the Safety of Life at Sea (SOLAS)."* (IAMSAR Manual VOL I, 1998:iii)

The first edition of the IAMSAR Manual was published in 1998. Being frequently updatet and published in new editions, it is divided into three volumes that provide a common aviation/maritime approach to SAR services on the different levels of the system:

- *Volume I Organization and Management*, discusses the global SAR system concept, establishment and improvement of national and regional SAR systems and co-operation with neighbouring States to provide effective and economical SAR services.
- *Volume II Mission Co-ordination*, assists personnel who plan and co- ordinate SAR operations and exercises.
- *Volume III Mobile Facilities*, is intended to be carried aboard rescue units, aircraft and vessels, to help with performance of a search, rescue or on-scene coordinator function, and with aspects of SAR that pertain to their own emergencies.

Already in the first edition the Aircraft Coordinator was mentioned, but in the IAMSAR Manual VOL I (1998) with only one sentence as a round up of the On Scene Coordinator chapter:

"When appropriate, an aircraft co-ordinator (ACO) may also be designated to assist with on-scene co-ordination of SAR aircraft".

The Volume III of this first edition focused on flight safety as the primary concern of the ACO, and stated that the OSC would typically stay in charge on the scene. The term *effectiveness* is mentioned in relation to ACO and the supervision of searches.

The 2016 issue of the IAMSAR manual Volume II contains a whole new chapter 7 called *"Multiple Aircraft SAR Operations"*, containing detailed information on the ACO-role based on the procedures of the Baltic ACO Manual. Thereby officially implementing these new procedures in all the countries that are members of the IMO and the ICAO, Norway included. In the book *Mass Rescue Operations* by the International Mass Rescue Federation (IMRF), the changes are referred to as follows:

"A significant amount of additional guidance on multiple aircraft SAR operations will be added to all three volumes of the IAMSAR Manual in its 2016 edition. In particular, procedures and principles will be described in a whole new chapter 7 to be added to IAMSAR Volume II, and a new section 5 to be added to Volume III. (International Mass Rescue Federation, 2015:145).

Meaning the contextual variable of the IAMSAR manual in my analytical model, is imposing a new dimension to the demands on the Norwegian SAR system.

4.3 International cooperation and agreements in the High North

International cooperation is a key element for future effective SAR in the High North. A crisis takes no notice of boundaries between states. Even though Norway has a well developed SAR service on its own, also compared to many other countries, the characteristics of the High North makes cooperation between nations extremely important. In addition to the mentioned international overall agreement on SAR cooperation amongst members of IMO and ICAO, there are in particular two other SAR agreements involving Norway and with a High North maritime perspective worth mentioning.

The Barents SAR agreement of 1995

The full name of this agreement is: *"Agreement between the Russian and the Norwegian government on cooperation in search and rescue of people suffering distress in the barents sea of 1995"*. It is based on a mutual desire to continue a long lasting cooperation on SAR in the Barents Sea. It follows up on the SAR Convention and IMO/ICAO conventions and manuals, and provides for a bilateral and regional cooperation on search and

rescue in the Barents Sea. And amongst other provisions, it sets the conditions for joint effort, and clarifies how requests for help are to be forwarded between Norway and Russia. And how cross-border effort is to be achieved and through which communication channels information is to be shared. Maybe most importantly it sets the stage for the annual Exercise Barents, hosted every second year by each of the parties. The SAR-part of the Exercise Barents in 2015 will be commented on in relation to the ACO-role.

The Arctic SAR agreement

The *"Agreement on cooperation on aeronautical and maritime search and rescue in the Arctic",* was signed in 2011 by the eight memberstates of the Arctic Council (Canada, Denmark, Iceland, Finland, Norway, Sweden, Russia and the United States). It also rests on the 1979 SAR Convention and the 1944 Chicago Convention (ICAO), and refers to procedures in the IAMSAR manual. The objective of the agreement is:

"...to strengthen aeronautical and maritime search and rescue cooperation and coordination in the Arctic" (Arctic SAR Agreement, 2011).

This agreement also resulted in the Exercise SAREX being established, aimed at training the parties organizations, authorities and capabilities in SAR. Most importantly maybe, the agreement dilimited and divided the whole polar basin, extending each nations search and rescue region (SSR) all the way up to the remote areas of the North Pole.

In addition to these agreements, there are several both bi- and trilateral SAR agreements between Norway and other Nordic countries. And also an extensive *Barents Euro-Arctic Council Agreement*, regarding land rescue in the Barents Region. But the two mentioned, are the most relevant to this thesis.

4.4 ACO role and new ACO procedures – what is it all about?

Several contries around the Baltic Sea (Finland, Denmark, Sweden) have already implemented the ACO procedures, and formally approved them for operational use. Many more contries (amongst these; Denmark, Sweden, UK, Belgium, Holland, Latvia, Lituania and Norway) have for a few years already sent personell from both their SAR coordination centres and SAR units to attend ACO-courses. The procedures taught in the course are described in the "*International manual for aircraft coordinator"*.

The aim of the manual is to *"...internationally standardize the basic principles used for a SAR mission where an ACO is activated"* (International Manual for Aircraft Coordinator, 2011:5).

The ACO manual contains specific procedyres that are to be regarded as guidelines only, and therefore will sometimes have to be modified to fit the situation. The service of an ACO is only *advisory*, and is not by any means positive aircraft *control.* This means that an aircraft commander participating as an SRU, will under these procedures always be responsible for the safety of his or her aircraft. The following figure gives a schematic example of what kind of procedures it is all about;

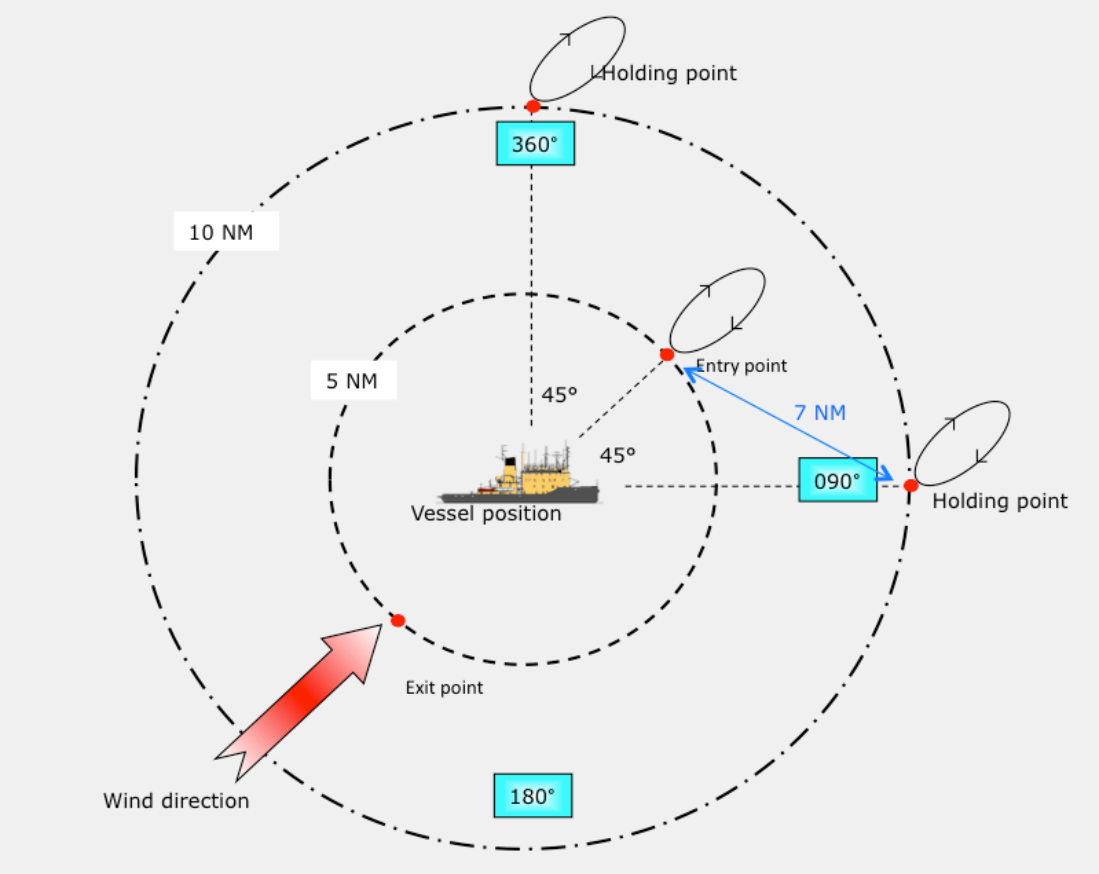


Figure 8: Example of specific ACO-procedures. Overview of the SAR airspace around a distressed vessel, with entry-, exit- and holding points for the safe coordination of SAR-helicopters into and out of the area (Lecture on ACO-course, 2014).

As mentioned in the introduction, the relationship between the person(s) or unit(s) acting as ACO and OSC has changed from subordination to equality. The new procedures

establish the two functions as equal-level and subordinate to the person acting as Sar Mission Coordinator (SMC) at JRCC, as illustrated in figure 5.

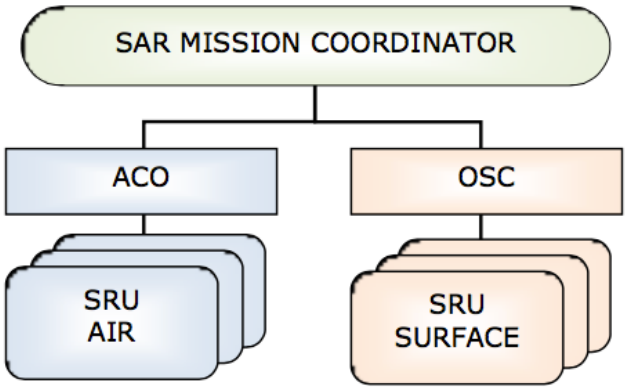


Figure 9: The equal-level relationship between the On Scene Coordinator and the Aircraft Coordinator under the SAR Mission Coordinator. (International Manual for Aircraft Coordinator, 2011:6)

4.5 ACO candidates in the High North

The 2016 version of the IAMSAR manual will states that ACOs should ideally be as close to the scene of a SAR incident as possible, and lists the following as possible ACO locations:

"...a fixed-wing aircraft, a helicopter, a ship, a fixed structure such as an oil rig, an ATS unit, a coordinating RCC or another appropriate land unit" (Draft new IAMSAR manual VOL III, 2016:85).

In the Norwegian SAR structure, there are in particular two platforms that have been tested and are highly regarded as capable of taking care of the ACO function. Both of them are military units. My assessment of the CG ships as ACO, is to some extent based on my observation in the Exercise NORD 16.

The Norwegian Coast Guard as ACO

The workload of an ACO can be very high. This also according to the Draft new IAMSAR manual VOL II (2016). The ACOs of the Exercise NORD 16 confirmed this in their written report:

"ACO is a two-person job, demanding competence and preplanning".

The bigger Coast Guard ships are ideal in the sense that they allow the ACO to be on-scene and with good radio-coverage in the case of an open sea incident. The operation rooms onboard these ships provide more than one working station, and have physical and technological characteristics that make them well suited for the task. The helicopter carrying ships are the most capable, depending on the availability of helicopter control offisers onboard. With one or more HCO onboard, and with radars approved for helicopter control, they will be able to maintain unmatched situational awareness over several SRUs. During Exercise NORD 16 the ACOs onboard NoCGV Senja provided ACO services to seven aerial SRUs. But most important for this thesis, is the Norwegian Coast Guards contionus presence in the High North. The ambition is to have one helicoptercarrying ship in the Fishery Protection Zone around Svalbard at all times year round (NORUT/SARiNOR-project, 2015). This zone is extending from just south of the Bear Island (halfway between mainland Norway and Spitsbergen), and well west, north and east of Spitsbergen. And with their commitment to SAR, they are most of the time the only relevant Norwegian ACO candidate actually present in the High North.

P3 Orion maritime patrol aircraft (MPA) of the 333 Squadron as ACO

The difference between a ship and an aircraft in terms of speed and endurance is obvious. The P3 Orion MPA is the only ACO candidate capable of reaching the far outskirts of the Norwegian SSR. From their base at Andøya they are able to reach the North Pole in four hours flying time (NORUT/SARiNOR-project, 2015). Being an more elevated platform (compared to a ship or even a helicopter), it will have a better possibility of communicating via radio with both aerial and surface SRUs long before they enter an area of SAR action. Its physical characteristics can accommodate two persons handling the ACO role.

On the downside they do not have the same precise flight radar as the helicopter carrying Coast Guard ships. And even though they patrol the High North areas frequently, their presence will not be as continual as the NoCG. They are not on any specific SAR alert, and even though they will often be able to this within a few hours when the situation so demands (especially on weekdays according to conversation with personell of the 333 Sdq), their official readiness for crisis management is on a 24 hour basis (NORUT/SARiNOR-project, 2015). Even though having the ability to drop a so-called *Survival Kit Air Dropable* (SKAD) to survivors in the sea, according to my informant from the 333 Squadron they do not have SAR training objectives in their training programmes. But due to their primary role as a maritime patrol aircraft, their ability to perform searches are formidable. So in

nominating the P3 as ACO, the JRCC potentially loses an important search asset. As my informant put it:

"The awareness on this meaning a search asset is lost, must be present. This puts an extra responsibilty for good assessment on the JRCC. It takes a high degree of competence and knowledge of our capacity, from the JRCC side".

This brings us over to the other ACO candidates mentioned in the IAMSAR manual.

Other candidates in the High North?

Helicopters are one obvious candidate as an ACO. But in a large scale SAR operation, I suspect that the SAR helicopters of the High North will be used in their primary role. As with the P3 Orion, a SAR helicopter will to a even lesser degree have the capacity to function as an ACO while performing a search. And certaintly not while performing a rescue. With a limited amount of helicopters available in the High North, it is highly unlikely that the JRCC wil appoint a helicopter as ACO. Non of my informants have suggested a helicopter as ACO.

Oil rigs have been mentioned, and might both in physical characteristics and personell-wise be a candidate if an incident happens in its proximity. An air traffic service unit of course as well. In the Exercise NORD 16, the scenario took place within an air traffic control zone. In this case the trained personell in the tower would have been the best candidate as ACO, had they had the necessary knowledge of the procedures. But their radar will not extend far from the coastline, and therefore will they very seldom be an obvious choice. But as we saw during the *MS Estonia* disaster, ATC personell can be airlifted to aid in aerial coordination in the area of SAR action.

At the JRCC South they have an interesting solution, as their operations room is equipped with a working station set up with the proper screens and systems that an air traffic controller needs. In situations demanding aerial coordination and SA, a person from the nearby ATC unit at Sola Airport will be called upon.

At the JRCC North they have not adopted this solution, and none of my informants from JRCC North mentioned this. What they *did* mention categorically, was that in their opinion JRCC North is *not capable* of taking on this function. As one informant put it:

"Simply impossible. Due to the lack of two-way communication with aerial units".

Another informant focused on their capacity:

"Plenty enough to do just being the rescue coordination center, and getting hold of resources".

This is also in line with what my Danish JRCC informant told me:

"Having an dedicated external ACO takes a great workload off the JRCC. Gives the JRCC the opportunity to focus on the bigger picture".

In a not so distant future (within a few years), the Norwegian Navy will have operational frigate-ships with helicopter embarked onboard. Also for these ships there is an ambition to operate in the High North. They will therefore with time possibly be a capable ACO candidate, but probably not to the same extent as the Coast Guard ships, due to their different primary roles. In a more distant future, remotely piloted aircraft might also serve effectively in this function. But this is well ahead of present time solutions.

4.6 Challenges of the Arctic/High North

The White Paper to Stortinget (2011-12) on the High North, comments on some of the challenges in the Arctic:

"Long distances, a demanding climate and limited availability of rescue personnel and equipment are well known characteristics of the Arctic region…it is important to be aware that time considerations, the distances involved and the harsh climate will make some rescue operations impossible, regardless of the resources allocated to search and rescue services."

My thesis focuses on the operations that *are* possible to conduct, but the remoteness of the High North definitely poses some serious challenges. The most obvious climatical challenge of the north is the cold temperature. The risk of icing is a threat to both ships and aircraft. And when personell is exposed to the sea temperatures of the Arctic without proper immersion or survival suits, the timeaspect comes quickly into play. For a person without a survival suit to stay alive for 90 minutes in these cold waters, will be an achievement. According to the IAMSAR manual (2013), there is a 50% chance of survival after 60 minutes in water at or below 5 degree celsius. Even so, most people die of drowning, not hypothermia, when being exposed unprotected to water (SINTEF/SARiNOR-project, 2016). The low temperature of the northern waters contribute by reducing bodily finctioning. The short survival time is a major concern in relation to a ship cathastrophy in Arctic waters. Hence; the aspect of time is utterly important in the High North.

For ship and aircraft operating in the High North, icing is a major concern. Temperatures below minus 10 degrees celcius combined with strong winds resulting in seaspray, pose a threat to ships and boats. The possibility of encountering this in the North Sea is very rare, but in the Arctic it is a serious hazard (https://en.wikipedia.org). For aircraft, and helicopters in particular, heavy icing is a major concern. Most modern helicopters intended for SAR use are anti-ici equipped. But, although being classified as ”all weather” SAR helicopters, the present time Sea King helicopters of the RoNAF 330 Squadron are not equipped with anti-icing measures other than on the engines and a very few other important systems. The new AW-101 rescue helicopters being brought into service during the period from 2017 through 2020, will be fully anti-ice equipped, including de-icing on rotor blades. This will enable them to fly in icing conditions, and therefore climb into clouds and fly over terrain, instead of staying low and in plus-range temperature figures, as the Sea Kings have to do when in clouds in cold conditions. This will mean shorter transit time for SAR helicopters in the near future.

A special meteorological phenomen in the north is polar lows. These are low pressure systems, containing seriuos icing hazard, found in the arctic (and antarctic) regions, and pose a significant threat to ships and aircraft in the area. They are small-scale and short-lived, and therefore also hard to predict and forecast (https://en.wikipedia.org). In a normal winterseason (they appear only between september through mai), five to 15 polar lows are expected, but the latter years there have been a more frequent appearence (metlex.met.no) due to specific winter conditions. Whether this is a sustaining trend remains to be seen. Together with the uncertainty of meteorological services of the High North, these polar lows contribute to the complex climatical picture in the High North.

With all this is mind, the remoteness of the area, and the few and scattered SAR resources of the High North, there will almost always be a race against time in High North operations. From the city and airport of Longyearbyen, out to the position where *Maksim Gorkiy* struck an iceberg for example, there was 160 nm (almost 300 kilometers). Even for the most modern of SAR helicopters, this is approximately 70 minutes of flying time depending on the wind. In addition to this comes the alarm phase, the time to get airborne, the time to locate personell and the time to establish a helicopter in hover ready to extract a person from the water. Which easily can take an hour in complex operations that demand some planning, fueling etc.

Development in the Barents Sea over the recent years have contributed with some assets that has improved readyness somewhat. Oil rigs moving north will provide both alternate landing sites and extra fueling opportunities for SAR helicopters. Even though wind, waves and bad weather may limit the possibility of landing, the rigs can provide both improved communication with, and enhanced situational awareness for, both JRCC and SRUs. More importantly for this thesis; with personell trained at helicopter operations, they will potentially be capable of contributing significantly to a SAR operation (in their vicinity). One of my Coast Guard informants, with experience from platform service, had a mentioning on their possible role:

"An oil rig will also work (as an ACO, authors remark)*, it is stable and not influenced to much by water, it is spacious…".*

This may seem as a thin justicication, as this only takes care of very basic needs. But according to Danish JRCC officials, there have already been several oil rig radiooperators from Norway attending their ACO course. And both the Baltic ACO manual and the IAMSAR manual in deed mention oil rigs as possible installations for the execution of an ACO function.

Offshore on several locations along the Noewegian coastline, the oil companies have established their own SAR service with all weather SAR helicopters. These are available to the Norwegian SAR system and the JRCCs by agreements, and it is from the governmental side a prioritized task to develop the cooperation with operators of other helicopter resources (White paper to Stortinget, 2001). Unfortunately the oil companies operating in the Barents Sea, have so far had no intention of establishing an offshore SAR helicopter base out to sea.

Another key aspect regarding the High North and the ability to perform large scale operations, is communication. Or rather, the lack of and shortness in communication. Especially above 75 degrees north there will be limited communication infrastructure. Geostationary satellites (e.g. Inmarsat and VSAT) orbiting above the equatorial line have a theoretical coverage limit of 81,3 degrees north. This is north of Svalbard. However, tests have shown unstable signaling and dropouts already from 70 degrees north (Kvamstad/SINTEF, 2013). Which is still on the Norwegian main land. This lack of communication in the High North poses a major challenge to create a common situational awareness between players, and not the least to facilitate for fast and effective decision making. The Irridium system is the only satellite system providing full coverage in Arctic

aereas, but it has flaws and is known to be everything but stable from a moving platform. The quality of voice is often poor, and the capacity of transmitting data is very limited.

For JRCC, this is a key concern. During Exercise NORD 16, a new communication system in the form of a chat-function was tested for the first time between JRCC and the Coast Guard vessel acting as both OSC and ACO. This seemed to function well technically. The acting ACOs commented on their chat with JRCC after the exercise;

"It stands clear to me that the chat towards JRCC must be more in the form of plain text, to make it more understandable".

One of my informants at JRCC knew this new system very well, and had some interesting thoughts on the subject:

"Chat can lead to more detailed control…that too many small messages is sent. Close to shore it will be most important. Where things happens fast. Offshore and over longer distances you have more time for communication."

I originally would think that it would be the other way around. That this would be a more useful tool in the High North. It has not been tested at those latitudes yet, but the chat shall theoretically transmit through both Inmarsat, VSAT and Irridium satellite systems. The messages require very little data capacity. Untill further the only relevant ACO candidate with the chat system installed will be the Coast Guard ships. The chat is not developed as an operational system intended for SAR. But according to my informant it will be further developed for JRCC use, with alarms and confirmation that the messages have been read and so forth.

The only way for the JRCC to communicate directly with for example the P3 Orion maritime patrol aircraft (MPA), is via satellite phone (Irridium system). The quality of speech over this option is according to JRCC informants *"very poor"*. The solution for them is then to contact the military Norwegian Joint Headquarters (NJHQ). There they can communicate in written messages with the MPA. This can hardly be seen as an effective measure for timely decision making from the JRCC under certain circumstances.

4.7 Large scale SAR operations and aircraft coordination

Of course there have been numerous large scale disasters involving many people happening on a regular basis all over the world. But for the Norwegian SAR service, and in

the High North-perspective, there are a few incidents that have influenced the organizations to a great extent. Based on document studies of reports and books, I have focused on the ones being presented in the following, and with the ACO-role as the main objective.

The Scandinavian Star disaster

In some ways the experiences from the 1990 Scandinavian Star ferry-disaster between Oslo (Norway) and Fredrikshavn (Denmark) marked the start of more detailed procedures for the execution of Aircraft Coordinator-duties. Word has it (lection at ACO-course in Denmark) that Swedish SAR-officials started to look into how aerial assets could enter and depart an area of distress, in an effecient and safe way. At the time of the Scandinavian Star-report, the term *"ACO"* was not yet established. In fact; international rules had no specific procedures for aircraft coordination, as it was considered a sub-function under the On-Scene Commander (now; On Scene Coordinator). The Scandinavian Star report put it this way:

"When the designated OSC lacks the expertise or the equipment to coordinate the air traffic involved in the operation, it may be appropriate to divide the OSC function and appoint an aircraft as OSC-Air. The international rules contain no separate provisions relating to OSC-Air, and the prevailing rules governing OSC are applied as far as is appropriate." (Scandinavian Star Report, 1991:169)

The report reveals that in fact there were no international rules in effect, that regulated the coordination of aerial units. The Scandinavian Star-report reveals the lack of air traffic coordination:

"A major criticism of the conduct of the OSC-Air was that no priority was assigned in the helicopter traffic." (Scandinavian Star Report, 1991:169)

A function that *was* in play in 1990, was that of the *coordinator surface search (CSS)*. If a suitable OSC was not available (i.e. a rescue unit or naval ship), a ship on-scene (e.g. a merchant ship) would be expected to assume the duties of the CSS. And further take on as many OSC duties as able to perform. This CSS would in almost any case not be capable of aircraft coordination.

The report tells about a Norwegian Sea King-helicopter entering the area of operation with fire fighters onboard. After having been placed in helicopter-queue upon arrival to the Scandinavian Star, he had to return to the mainland for refueling, still with the firefighters on board. The captain of the Sea King helicopter objectet strongly to this, but the result was

nevertheless that time was lost. Furthermore; the CSS was not aware of the appointment of an OSC-Air untill after the rescue-operation was complete. Finally one of the units appointed as an OSC-Air did not have the means to even communicate with the CSS.

The MS Estonia disaster

Another devastating ferry-disaster occured in 1994 when the ferry *MS Estonia* in transit from Tallinn (Estonia) to Stockholm (Sweden) capsized and sank. At the height of the helicopter operations, there would be a total of 12 helicopters in the search area (The Joint Accident Investigation Commision, 1997). The Estonia report have several mentionings about the coordination of aerial units. In many ways summarized by the following finding;

" In this kind of major air operation, it is essential that the OSC is assisted by personnel with experience of air traffic control. The air operation co-ordinator was not in place during the critical hours of darkness, and the air traffic controller needed for supervising the air traffic and for ensuring flight safety, did not arrive until 0945 hrs. When the co-ordinator surface search and the air operation co-ordinator and his assistant had arrived on board the MS SILJA EUROPA, the staff of the OSC is considered to have reached a standard sufficient for conducting an operation of this magnitude. However, this did not happen until about 45 minutes after the last survivors were found." (Landin, 2010).

There are several other cases that would have deserved to be investigated thoroughly in the face of aircraft coordination. E.g. the *MS Costa Concordia*-disaster on the 13th of January 2012, where helicopters were assigned as *"ccordinators of the air traffic"* (The Joint Accident Investigation Commision, 1997:210). But as the Scandinavian Star- and the Estonia-disasters both have influenced the making of the Baltic ACO-procedures, and also are very much in the minds of SAR-personell in the Nordic countries, I regard them as sufficient to enlighten the theme. Together with the successfull rescue-operation of all personell (except those kept onboard by the captain) from the *Maksim Gorkiy* in 1989 and the evacuation from the *Norman Atlantic* ferry in 2014, where passengers and crew *"...were recovered, over many hours, by a carefully coordinated stream of helicopters"*. (International Mass Rescue Federation, 2015)

4.8 ACO experiences in the Norwegian SAR service in recent years

There have in recent years been a few exercises where the new ACO-procedures have to some extent been tested in Norway. There have also been live missions where an ACO have

been appointed by both JRCCs (north and south). From different documents and reports, and also from information recieved from informants at the JRCC and commanders of participating units, the following exercises and operations are analyzed focusing on conclusions and remarks made regarding the ACO-role.

Skag Ex 11

First of all there is the large exercise *"Skag Ex 11"* in the Oslo-fjord in 2011, which scenario-wise very much reminded of the Scandinavian Star-accident. This was the first exercise in Norway in which the SMC appointed an ACO to act alongside the OSC in the second tier of decision making . The procedures used were from the *International Manual for Aircraft Coordinator,* making the evaluation report very relevant to my thesis. The airborne SRUs included five rescue helicopters from four different nations (Norway, Sweden, Denmark and Finland), and in addition to this another three ambulance helicopters, a police helicopter and two fixed-wing aircraft participated. A transfer of the ACO function between a fixed-wing aircraft and the NoCGV *Bergen* had been planned, but was cancelled prior to the exercise, due to the aircraft being otherwise engaged. Two helicopter control officers (HCOs) onboard *NoCGV Bergen* therefore served as ACO for the duration of the exercise. A key finding on the ACO-role stated that;

"*The simultaneous use of an On Scene Coordinator (OSC) and an Aircraft Coordinator (ACO) was effective, although some uncertainty arose regarding lines of command and communications between them vis-à-vis the SAR Mission Coordinator (SMC) at JRCC-SN (south)"* (SkagEx11 Evaluation Report, 2012).

Being deemed effective, the overall assessment was that the ACO function performed well, but needs further development. According to the evaluator, the ACO exhibited good situational awareness in a high-stress situation, was able to quickly establish an air coordination plan, and also managed to improvise and use this plan in an effective and safe way. The evaluator concluded that:

"...flight safety was well maintained, and the ACO´s coordination of SRUs was generally effective under the circumstances." (SkagEx11 Evaluation Report, 2012:39)

This points to the possible positive conclusion that the ACO-role, as my main variable and as discribed in my analytical model, *will* lead to improved operative performance in form

of increased flight safety, efficiency and effectiveness. On the other hand, the report also points to some shortcomings. The high workload put upon the ACO, led to the ACO not being able to present a flow-plan for helicopters, and that the capacity was therefore not used to the full extent. At times there were several helicopters in holding, and at times there were none helicopters airlifting personell from the vessel in distress. These shortcomings coincide to a great extent with my observations during the Exercise NORD 16.

The report also pointed to another shortcoming, that is was not clear to whom the ACO would report which helicopters were leaving the area, and likewise who was to give the ACO evacuation points for various helicopters. The question being whether it was the SMC or the OSC who should be the point of contact in these type of coordination. My observation during Exercise NORD 16 was that the prioritisation in regards to evacuation points remain an issue. In the sense that it remains a complex challenge for the JRCC via the ACO to decide where helicopters are to transport patients and survivors. The most complex aspect seems to be the cooperation between these two functions and the health services, when it comes to helicopter transport. But regarding the lines of communication, the Exercise NORD 16 proved that a step forward has been taken, as there were no hesitation as to whom the ACO would report the whereabouts of the helicopters to. This would be straight to the JRCC, and not formally via the OSC.

A pilot in one of the SAR-helicopters, described having an ACO on the scene of SkagEx 11 as: *"luxurious",* and *"extremely pleasant"*(Skag Ex 11 pilot conversation, 2014).

This finding also coincide with many of the feedbacks from SRUs during Exercise NORD 16. And thereby maybe contributing to the SRUs being mentally able to concentrate on their main task of retrieving people from a ship or the sea, instead of having to worry to much about the whereabouts of other SRUs.

The evaluation report was inconclusive about whether the location of the ACO on a surface vessel was ideal. Interestingly enough, the OSC-evaluators during SkagEX 11 felt that the OSC should have been given a superior responsibility also for the ACO function. And even though the OSC-ACO relation was deemed effective, the report also concluded that evacuation of persons via helicopters proved to be slower than desired.

Exercise Barents Rescue 2013

The Barents Rescue 2013 exercise was hosted by the Norwegian Directorate for Civil Protection in the Lyngen/Troms area in the north of Norway, with participants also from

Russia, Sweden and Finland. The scenario was based on an excisting real-life threat posed by a huge rock mass expected to slide out in the fjord, causing a tsunami and massive destruction in the area. A total of five helicopters participated, one of them being a swedish police helicopter. In addition to the Coast Guard vessel *KV Andenes* serving as the ACO, a Norwegian P3 Orion MPA mainly provided relay services to the ACO during the exercise. As this was a SAR land-scenario ashore, the procedures would have to be modified to suit the needs. Also in this exercise the plan for a full handover of ACO-duties from a ship to an aircraft was abandoned from different reasons. The overall findings in the evaluation report do not necessarily represent a step forward for the ACO-role. Amongst several findings were this statement:

"...unclear organisation and communication with ACO, which resulted in sub-optimal resource priorities." (Barents Rescue 2013 Evaluation:45)

The report further points to shared situational understanding as a shortcoming. The internal coordination onboard *NoCGV Andenes* was deemed good (as one would expect), but on the other hand the external coordination was described as downright poor. Mostly due to a total lack of communication between the ACO and the incident commander (IC) of the Police. A lack of communication and coordination also excisted between the JRCC and the Rescue Sub-Centre (RSC). But the JRCC and the ACO had communication lines in place, the result being that the JRCC and the ACO therefore chose to make its own prioritisations and assigned incoming air units tasks to the best of its ability. This whole lack of external communication between central players resulted in the aerial units being used only in the two smallest incidents of the scenario. The biggest incident did not receive the attention of the JRCC and the ACO that it deserved. (Barents Rescue 2013 Evaluation, 2013). It must be underlined that this exercise was held ashore, and therefore do not represent the High North out-to-sea aspect in a righteous manner. The P3 Orion crew in this exercise deemed the Coast Guard ship as a:

"...better candidate as an ACO in this scenarioe with its radar for better situational awareness. (P3 Orion Crew report on BR 13).

This is interesting, but not necessarily applicable when the scenario is moved to e.g. the waters around Svalbard, as I will get back to in the analyzes chapter.

Exercise Barents 2015

The Exercise Barents is an annual exercise held according to the bilateral Barents SAR Agreement of 1995 between Russia and Norway. It consists of both a SAR scenario and an oil pollution scenario. From the Norwegian aviation side a Sea King SAR-helicopter and a cicilian maritime patrol aircraft participated in 2015. From the Russian side two helicopters and one fixed-wing surveillance aircraft participated. The NoCGV *Andenes* was given the task of performing as ACO. In addition NoCGV *Andenes* was given the task as some sort of ”Sub-OSC” due to language barriers. Onboard NoGCV *Andenes* was an interpreter, the main concern being that Russian pilots do not speak English at all. Communication between the ACO and the Russian aerial SRUs would otherwise be impossible. Opposed to what was planned for and agreed on beforehand, the Russian aerial units did not transmit their IFF/transponder during the exercise (meaning they will not appear as a ”target” on the Coast Guard ship acting as ACOs radar). This poses a serious flight safety issue (JRCC North Report on Exercise Barents 2015).

These exercises have traditionally neither had any joint debriefing, nor is a joint evaluation report issued.

4.9 Presentation of data – audiofiles Exercise NORD 16

From the Coast Guard vessel, with a helicopter control officer (HCO) acting as an ACO, I was given access to the exercise audiofiles derived from the ACO-frequency (Air-to-air 123,1 MHz). (Except from a time period of approximately one hour, when due to helicopter landing and launching, the recording was routinely directed to a different frequency). These were analyzed and categorized depending on what the purpose of the transmission was. Only the main message was included in the analyzation. Meaning all readbacks and confirmations were left out from categorization.

Transmissions *directly* regarding effectiveness and flight safety were few compared to the total number. But both standardized reports, and also messages on coordination/information and prioritization, has elements of these two main research question dependent variables in them.

	Coordination /information	Prioritization	Effectiveness	Flight safety	Reports	Total
ACO to SRU	23	17	5	14		59
SRU to ACO	20	1	4	4	63	92
SRU to SRU	6			1		7
Total	49	18	9	19	63	158

Figure 10: Diagram showing the number of messages given over the ACO-frequency during the Exercise NORD 16. By whom and to whom, vertically, and regarding what, horizontally.

The total number of 158 ”main messages” were transmitted over a time period of 168 minutes. Meaning *nearly one main message per minute*. Including *readbacks* and *confirmations*, nearly 500 transmissions were made in the same timeperiod. Increasing the number of transmissions to nearly *three per minute*. As the diagram shows, only a few SRU to SRU-messages were without the involvement of the ACO, illustrating the pressure that was put upon the ACO in this case.

4.10 Survey conducted at an international ACO course

The survey (appendix 2) was conducted at an early stage in my research process, amongst fellow course participants on an ACO course held by the Danish JRCC in Fredrikshavn, Denmark. It consisted of nine questions, with different answering alternatives multiple-choice style. On some of the questions the respondents were asked to range their answer from 1 (not at all) through 5 (significantly), based on to what extent they would agree to the proposition in the question. As earlier discussed, the questioning in relation to my thesis was in a bit , I therefore ended up analysing only a few of the questions, by the old fashioned way, a pen and a paper. But the survey nevertheless gave som interesting perspectives worth mentioning. In total there were 23 respondents from eight different nations. Out of these 14 had any previous excperience with the ACO role in either real missions or exercise. Out of the 23, respectively 22 and 21 assessed a (trained) fixed wing, or a military ship with HCO on board, as a good ACO candidate. Third to this was a fixed structure (e.g. oil rig), which by 12 respondents was seen as a potential ACO unit. Out of the 23 respondents, respectively 22 and 23 ranged their answers on whether an ACO will provide for improved flight safety and effiency in an operation, to the two highest gradings (4 or 5 (*significantly*)). 19 out of 23 gave the maximum score (5) to the question whether an ACO would be useful in a mass rescue operation (MRO). The remaining four gave the second-highest grade of 4 to this question. The answers must be

seen in coherence with the fact that the survey was answered at the end of the one week ACO course (theory and simulator), that received concurred and positive evaluation.

5 Analyzes of findings in relation to research questions

In this chapter the empiri and findings will be further analyzed, and seen in connection with, the main and sub research questions. In doing this I will start with the sub-thesis and end up answering the main research question.

5.1 High North effect on procedures and improvisation

With my background as a SAR helicopter pilot in the north of Norway for 13 years, and as one of the operators of the national operations watch at the military NJHQ, my experience has always been coloured by the arctic dimension, so to speek. As I entered into the theme for this paper, I was given the opportunity to attend a Danish ACO-course. Here I saw the procedures played out in a simulator environment, and my mind started to compare things to my own normal environment. How will these procedures work at my level in the Norwegian SAR system? What about the remote areas of the High North? This led to the first sub-question of my thesis:

How will the context of the High North affect the ACO-role with regards to;

a) procedures,
and;
b) improvisation.

I may not seem very obvious to look into *improvisation* in this context. But already being an acknowledged theory in relation to crisis management, my overall experience with SAR can in this area be summoned in one phrase: *you can not plan for everything.* And the things you have not planned for, will some way or the other also have to be dealt with. Then improvisation comes into play and becomes important. And the more out of the ordinary, the more important this quality becomes. As is can be asserted that the case will be with a large scale incident in the High North. The reason being it will be an extremely rare incident, maybe happening once every second decade in a given area. But first I will discuss how the specific ACO procedures is influenced by the High North, with referance to the data collected.

The historical backdrop for the new ACO procedures, being formally introduced through the 2016 edition of the IAMSAR manual, has first and foremost been the devastating ferry disasters of the *MS Estonia* and the *MS Scandinavian Star*. Driven by the desire to save lives in future large scale SAR operations, Swedish, Finnish and Danish SAR officials have

jointly developed procedures, and educated SAR personell from 12 different north-european nations over the last ten years or so. They have developed procedures aimed at making the use of multiple SRUs in an incident both safer and more effective. The *MS Estonia* disaster happened in the Baltic Sea between Stochholm and Tallin, and the *MS Scandinavian Star* disaster between Norway and Denmark. Both of them in waters where resources were and are plentiful, and distances are manageable. None of them in the waters of the High North. The *Maksim Gorkiy* SAR operation *did* take place in the arctic waters of the High North, some 160 nautical miles west of Spitsbergen, and was an astonishing acchievement of success. Mostly because of the tremendious efforts of the NoCGV Senja, but also partly because of the relatively nice conditions of the day. One of the pilots of the Norwegian P3 Orion maritime patrol aircraft comments on this in the book about the *Maksim Gorkiy* incident:

"Several amongst the crew had been in the same area a week earlier, when the winds were 45 knots. We were pretty sure that if this had happened under such circumstances, the outcome would have been quite different" (Hovden, 2012:54)

High North effect on procedures

A few of my interview informants have experienced ACO operations in the High North. A crew member onboard the Norwegian P3 Orion MPA told an exciting story scrambling towards a sinking boat in the Norwegian Sea:

"We were retasked from a different mission, and turned at once. We had an estimated time of arrival 45 minutes prior to the first helicopters arrival. The two helicopters had a spacing of about 20 minutes. The search phase was short. We located two persons in a life raft and established METOC (weather- and wave conditions, authors remark). *All was done in time for inbrief with the first helicopter. Advisory message was given according to procedures, one helicopter was taken in low, the other higher. Everything went very smooth".*

In this story one can in a way find evidence that the the High North characteristics that make operations challenging, in regards to *procedures* can make operations easier. Or at least more *manageable.* The long distances and prolonged transit times gave in this example the ACO time to prepare and set up for precise use of the procedures. As opposed to during the Exercise NORD, where the ACOs reported very high workload. Of course, in this example there were only two helicopters involved. But nevertheless, distance and time might make the initiation of procedures less stressful for the ACO. Which of course rests on the assumption that the ACO is on station before all the SRUs are in place. An assumption that, with

reference to readiness and alert times, not necessarily often will be fulfilled. The P3 Orion planes are on a 24-hour callout response time. But under such circumstances that a mass rescue operation in the High North will represent, every measure will be taken from the whole Norwegian SAR system in order to provide whatever resource can be useful, in the least amount of time. Included military assets. This according to my own experiences as an operator at the national operations desk of the Norwegian Joint Headquarters (NJHQ). Ringen T. and Eriksen M. (2015) have, on the downside of this, in their master thesis on *improvised cooperation between the JRCC and NJHQ*, conluded that there are insufficiencies in this relationship. As they conclude that the JRCC and NJHQ common SA is affected by reactivity and a suboptimal sharing of information.

Nevertheless, the presence of the two military units capable of performing as ACO in the High North, must be seen as a strengthening of the ability to establish these procedures when needed. The larger offshore ships of the NoCG are the ones manned with HCOs. With their manning and on scene endurance they are in many respects the best ACO candidate. In the last couple of years the CG ships have not had helicopter embarked due to the introduction of a new helicopter type. Meaning that the HCOs have not necessarily been onboard, or at least not up to their normal standard when it comes to helicopter controlling. However, as the new helicopter type is becoming operational, these dilemmas will improve in the coming couple of years. As previously mentioned, the CG`s ambition is to have one helicopter carrying ship in the waters around Svalbard (petro.no, 2015). My experience as a national watch operator at NJHQ, is that the centre of gravity for coast guard activity in the North, is around Bear Island (Norwegian: Bjørnøya), halfway between Norways mainland and Spitsbergen (largest island in the Svalbard archipelago). This area represents a center point in the part of Norwegian SRR north of the Arctic circle. This also gives the High North dimension a somewhat positive effect on ACO procedures, in the fact that the most capable ACO candidate´s main area of operation is in the very centre of the High North and Norwegian search and rescue region.

The procedures, as pictured in figure 8, are clearly developed as a concept out to sea. And in the High North the most likely scenario where a mass rescue operation needs to be conducted, is at sea. Most of the High North area where activity is present, is plain sea. In addition one can also easily vision a scenario where one of the every-day numerous transpolar flights of passenger planes, makes an emergency landing in the polar basin. So; in regards to

both sea and ice rescue operations, the High North context in a way is ideal for the procedures themselves. Or the other way around; the procedures will fit the High North.

A couple of the very central shortcomings during both exercise Barents Rescue and also Exercise NORD 16, was that the interaction between both ACOs and SRUs on one side, and the Police and the health services on the other side, did simply not work. In the High North these shortcomings will not be present in a maritime large scale SAR situation, as there will be no direct interaction between the sea/air- and land domain whatsoever. And the shortcomings of reporting due to short distances, should neither be of any concern. Neither should the possible overload of the ACO, as reported almost was the case during Exercise NORD 16, be given anything but better conditions in the High North aspect.

With the difference in distance and time aspect as compared to Exercise NORD 16, the ACO function will in some ways therefore be more manageable. The pressure put upon the ACO during the Exercise NORD 16, with audio files revealing that the ACO on average had to respond three times pr minute over several hours, will probably not be the case further out to sea. Thus giving the ACO time to close shortcomings identified during both SkagEx 11 (e.g. no flow plan was developed) and Exercise NORD 16 (e.g. no time to fulfill the reporting regime in accordance with the procedures). And according to my survey, nearly 99 % of the respondents pointed to a fixed wing aircraft or a HCO-manned military ship as the best ACO candidate. In Norway these to capacities are almost exclusively situated in the High North. Hence, in relation to procedures, the ACO will actually have the best starting point in the High North.

From procedures on to the ability to improvise around them. As one of the ACO candidate informants highlighted in an interview;

"ACO procedyres are a way of approaching a problem. People have done similar things before. An HCO as an ACO with an extra person, is an ideal situation. It does not often exist in a SAR situation."

This brings me over to the improvisation side of things.

High North effect on need for improvisation

Obviously, all possible SAR scenarios can never be planned for in a way that takes care of every aspect. In his master thesis on what incident should be dimensioning for the SAR service around Svalbard, Haagensli (2016), argues that the likelyhood of a passenger plane

ditching in water or landing on the ice, must be adressed properly in the Norwegian SAR system. Such a scenario will further challenge the systems ability to improvise.As this thesis can be proof of, so far the focus in the High North has been primarily on ship related incidents.

As accounted for earlier, the High North is still very limited when it comes to broadband and communication. To work as intended, the ACO procedures demand reliable communication between the ACO and the JRCC. In the book on the *Maksim Gorkiy* operation, Hovden (2012) comments on the lack of information from, and communication with JRCC North. He states that the NoGCV *Senja* received no recommendations nor plans of action from the operational level at JRCC. The crew onboard the CG vessel had to take care of the situation and make their own decisions based on their own experience. He further states that JRCC North allocated plane and helicopter resources without thinking through how NoCGV *Senja* would be able to coordinate and attend to the safety of these units 160 nm from the nearest airport. Neither JRCC North, nor the NoRAF representative at JRCC, made any decisions on whether dispensations or temporarily permissions had to be issued. Hovden summes it up in the following sentence;

"One had to set the need to save human lives up against the risk of exposing own personell, helicopter crews and the people in distress to great danger, by having to improvise and make timely decisions as the operation went along." (Hovden, 2012:138)

Event though this operation happened more than 25 years ago, the premises for communication in the High North have so far not changed to a great degree. As a SAR and potential ACO resource, especially a P3 Orion aircraft will to a great extent have to rely on its own judgement. Simply because JRCC are still unable to communicate with the P3 in an effective way. At least this will be true in the beginning of an operation, when JRCC situational awareness maybe is based on reports from the same P3. The initial fases of an operation is also when decisions will be the most crucial. So the ability to improvise will still be important in the High North. The ACOs can still not expect to be fed with complete plans of action from the operational leadership on the mainland. For the CG there might be a change to this in the not so distant future, as the military recently were able to get broadband coverage at 82 degrees north (north of Spitsbergen) (forsvaret.no, 2016). So far in only 12 out of the 24 hours in a day, due to satellite coverage. With the use of a few more satellites, the solution should provide broadband around the clock. The commander of the CG ship where

the tests are conducted from, emphasizes that this will be of great importance first and foremost in SAR operations. The preliminary solution will by the end of this year be installed in one of the CG ships. In the P3 Orion aircraft this solution will probably not be implemented in the aircraft´s lifespan. So the improvement will not affect more than one ACO candidate in the High North.

In relation to improvisation, this means that there might be quite different challenges and problems to work around, depending on which unit is appointed the ACO-duties. An informant from the 333 Squadron operating the P3, suggested a remedy to such a dilemma in terms of reporting. He pointed to the need for a chain of command, and although being aware of the equality of the OSC and the ACO under the SAR mission commander (SMC), he suggested that one of them might have a larger responsibility for reporting back to the SMC. Into this I read that he drew attention to the need for flexibility in the procedures. And as explained in the theory chapter on improvisation, flexibility is by some believed to be an organisational requirement, in order to be able to respond to unanticipated occurrences. The same informant commented that;

"...even without the formal ACO education, one should be able to take on a role in an operation".

My beliefs are that this will be very much true in the High North. One does in this area not simply have the luxury to suspend any potential player or asset from participating in a large scale SAR operation. The scarcity of resources in due time in the north determines this. And this again points to the need for an ability to improvise and find a workaround to problems. As the different ACO candidates have different characteristics, and this difference might increase or decrease by hopefully inevitable communicational developments in the High North, the procedures will need to maintain flexible to some degree. To believe that the procedures can be other than a framework for handling a major crisis in these Arctic areas, is in a way a bit naive. Changes in, and development of the procedures, will of course take place. This is of course not a contradiction in regards to the need for training and exercise. In fact, the ability to improvise in this field rely on competence and expertise.

Knowledge-based improvisation

Although being simplified, the ACO-procedures will have to be adjusted on a situation-to-situation basis. In the open seas, the pictured procedures, with different entry-, holding- and exitpoints placed on 5- and 10-nautical mile circles, may be sufficient and applicable. But

in most cases procedures will have to be modified to fit the environment and the ongoing rescue-operation. Obstructions in the form of both terrain and manmade structures (e.g. an oil platform) has immediate impact on the preparation for a successfull operation. Communication in the high north is another well-known challenge, and as demonstrated in the Exercise NORD 16, a problem that has to be overcome. In such circumstances *improvisation* may become a neccessary work-around. The dialogue between the ACO and the SRUs during NORD 16 showed several examples of such work-arounds. Amongst them were this dialogue derived from the audiofiles:

SRU to ACO: *"Lifting from Legevakta, unable to reach you from ground at Legevakta".*

ACO to SRU*: "Roger. Proceed to Mørkvedbukta for further instructions".*

SRU to ACO*: "Proceed to Mørkvedbukta. And for information, unable to reach you from ground outside 330 Squadron and Legevakta* (landing site, authors comment) *so far."*

In this case the SRU overcame the trouble he had contacting the ACO onboard the CG vessel, by lifting into hover. The same SRU at one point acted spontaneously as a relay station for another SRU, and requested instructions from the ACO on its behalf:

SRU to ACO: *"XX also request instructions. He is on ground at MUS".*

It turned out that alle the SRUs had to lift into hover to be able to communicate at certain landing sites. And although the procedure of issuing reports from the ground had been stressed as a key point in flight safety, all units found a workaround to the problem. It seemed like this came intuitive to all the SRUs participating. Later on, another work-around was initiated by using air traffic control (Bodø Tower) monitoring the ACO-frequency, as a relay station. Also this was initiated by several SRUs independently.

And in this the SRUs also demonstrated that their understood the importance of "sticking to" the reporting procedures. These examples of improvisation observed were in my view founded on knowledge of the standing procedures. Another example of improvisation during Exercise Nord 16 was that the VHF ATC-frequency in use was transmitted over UFH to give the ACO the necessary SA. This type of improvisation (the solution came up during the planning process) is dependent on training and knowledge of each others capacities.

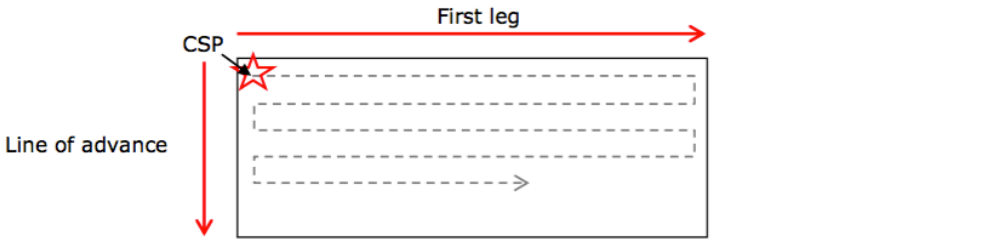
This brings us over to the educational perspective.

5.2 *Education, training and exercise*

The need for education and training in this type of topic, is kind of obvious. All my informants and respondents, have without exception stated that there is a need for this. One of the commanders of a helicopter SRU during Exercise NORD 16, made an interesting distinction, as he felt the need for *education* to be more of a neccessity for the ACO. But he clearly stated that there will be a need for *training and exercise* on every participant. Education, training and exercise will always be a central variable in questions revolving around readiness, and through interviews and other empiri, the aspect of competence in the ACO field have been thoroughly discussed and brought up. This chapter will sum up the most important findings, and eventually conclude on some key aspects. My second sub-thesis was as follows:

How will new and more specific ACO-procedures affect the need for formal education, training and exercise?

The ACO-procedures are designed to be simple, but reports and search instructions are in some ways complicated in its nature. As an example from the daytime Exercise NORD 16 shows. In this exercise the search-areas were pre-planned (because of the time available) and named search area 1, 2, 3…etc. The extension of all the search areas were known to all of the SRUs, and they were even provided to them on a map. Thereby making the following example a stripped down and simple search area instruction. According to the new procedures in the coming IAMSAR manual, search area parameters are to be given in the form of a *commence search point* (a lat-long position), a *first leg* (with direction in degrees and a range/length), a *line of advance* (general direction of the search pattern – e.g. 90 degrees on the direction of the first leg) and a *lane/track spacing* (distance between the parallell tracks of the search pattern flown). The following figure illustrate these parameters:



E.g. *"Commence Search point 5910N 02000E, First leg 090°/9NM, Line of advance 180°/4NM. Lane spacing 0.2 NM"*

Figure 11: Illustration of search instructions (International Manual for Aircraft Coordinator, 2011:14).

Hence, although being standardized, and well known by both ACO and SRU well ahead of the Exercise NORD 16, the following dialog derived from the audio files over the aerial VHF 123.1 MHz ACO-frequency between the ACO and a SRU (helicopter) over search area instructions, can illustrate the complexity:

***ACO to SRU**: "We have created a search area. Instructions are for you to search area 1. Commence search point northwest corner. First leg 045* (degrees). *3,5 nautical miles."*

***SRU to ACO** (readback): "Search area 1. 3,5 nautical miles wide. Search direction 045."*

Already in this initial instruction from the ACO to the helicopter crew, there are several misunderstandings or inaccuracies present. The ACO does not mention track spacing or line of advance. The latter meaning the SRU could have chosen the general direction of the search pattern in a 180 degree wrong direction (e.g searching north instead of south) and thereby commencing the search in the wrong area. The SRU responds (reads back) the instruction, but instead of repeating the *"First leg 045"* instruction, the crew interpret this as *"Search **direction** 045"*. The result of this in the exercise was that the SRU searched the area 90 degrees off the desired direction. Eleven minutes later the ACO apparently have realised the instructions were incomplete, and comes back with complementary instructions:

***ACO to SRU**: "Update on search area. First leg 045. 3,5 miles. Mean line of advance 135 (degrees). 3,5 nautical miles. Track spacing 0,2 (nm)."*

***SRU to ACO**: "Copy all."*

This example demonstrates the level of precision needed for a search to be effective already from the start. In the cold waters of the high north, misunderstood or incomplete search instructions could mean that precious minutes are lost. And for a person in the water, minutes can be the difference between life and death. For this level of precision to be reached, realistic training and exercises are needed. Education in the form of a course with simulator-training, as in the already existing Danish course, is a good start. But unless this is followed by annual training, the experience will soon be forgotten, and certaintly not automated in any sense of the word. As would be the best guarantee for a good result facing a large scale SAR operation.

As the new IAMSAR manual will state:

" The new text prepared for the 2016 edition of IAMSAR says that: In order to ensure the best standard of SAR operations and safety, people likely to be designated as ACOs should be specially trained to carry out this duty. Once trained, SAR authorities should ensure that exercises take place to train ACOs and to practice multiple aircraft operations." (International Mass Rescue Federation, 2015)

This will formally inflict the Norwegian SAR system with ACO training objectives to be met.

Is there capacity in the Norwegian SAR system to train and exercise this concept?

One of the JRCC informants being interviewed, had some doubts on whether it will be possible to train this concept effectively:

"...we are already struggling to get enough helicopters to participate in the exercises that are mandatory." (authors translation).

But at the SRU and ACO level, the capacity to train this was not seen as something of a challenge. On the contrary, it seemed to be a clear consensus that this would not put too high demands on their organisations. An informant at the Coast Guard´s *Center of Competence*, responsible for all SAR in both the Coast Guard and the Navy, put it this way:

"The planes are out there all the time. And we (the Coast Guard, authors remark) *train regularly on SAR. On every mission in fact…should not be a problem at all."*

This simplification of a possible capacity-problem, seems to be the melody also at the SRU level. As a SAR helicopter pilot puts it:

"It may be enough with a unit-wise orientation, to ensure that one has a good understanding of what the concept is all about".

In fact; on the ACO and SRU level no comments were made, neither in the interviews nor in the written feedbacks from the Exercise NORD 16, that this would trigger extra resources in terms of economy or other aspects. I suspect this will be viewed different upon from a higher authority level. My experience from the NJHQ points to this conclusion. But the fact is that many units are *"out there training anyway",* as one interviewee expressed it.

How can training and exercise for large scale SAR be taken care of?

There may be a contradiction between training and exercise for worst case scenarios, e.g. a cruise ship on fire in the High North, and the fact that such an incident may not even happen once in every second decade in a given area. This means that SAR personell will quite simply not be able to gain the necessary experience on these types of challenges through ordinary service. And therefore the need for training and exercixe is imminent. And there are already some exercises adressing these issues.

In reviewing reports from the latest years of the annual Exercise Barents, co-hosted by Norway and Russia, I have registrered that there are on average two to three helicopters, and one or two aircraft, involved. Which as a starting point may be ideal for the ACO-function to be trained. But like in the 2015 Exercise Barents, the JRCC log report reveals that the training gained is deficient:

At 09:43 NoCGV *Andenes* was appointed ACO by MRCC Murmansk.

At 10:26 already, the one Russian helicopter and airplane were withdrawn.

For this exercise this meant that NoCGV *Andenes* function as ACO effectively lasted for 43 minutes. And during this period the Norwegian SAR helicopter participating had not even been given its search instructions. In fact, it had not yet lifted off from its pre-exercise forward operating base at Vadsø. Effectively; in this exercise the training objectives of the ACO were not met to any certain extent. At least not anywhere near what one must expect an ACO to handle in a real large scale SAR scenario.

These Barents exercises seem to have a history of unsufficiency when it comes to ACO training. Both because the scenario often is very preplanned in time and space. (This was also the case with Exercise NORD 16, but that exercise did give the ACOs challenges over several hours). But also because formalities regarding e.g. border crossing between Norway and Russia, seem to limit the amount of ”freeplay” during the ecercise substantially. In addition to this the Russian pilots are very limited in english. A Norwegian-Russian interpretor is always needed and present onboard the NoCG ship participating. And with the Russian aerial units having their transponder set to a mode not giving away their position (as was agreed upon prior to the exercise in 2015), these exercises seem for the ACO to be limited purely to flight safety, and not to any extent about effectiveness.

When it comes to participation, from the Norwegian side the latter years, only one or two SAR helicopters have often been present. And of these two, one is often the one helicopter on duty call in Finnmark. So the possibility of this helicopter participating is somewhat contingent. Meaning there will often be only one crew gaining the experience.

Having in mind there are four or five crew on each SAR helicopter base, it seems fair to conclude that the Barents exercises are not nearly adequaty in order to maintain the whole SAR organisation up to speed on ACO procedures. In Denmark, according to my JRCC interviewee, there is a standard stating that every person participating in ACO duties are to have one either real live mission, or one ACO exercise per year. The question is then; how can this be managed in Norway?

Smaller, more frequent ACO-exercises

With my own experience as being part of the planning team for the Exercise NORD 16, and having been a SAR helicopter pilot for more than a decade, my conclusion is that in order to fulfill the need for specific ACO training, the solution seems to be smaller and more frequent exercises. As several informants and respondents have mentioned, most of the units that can take a part in these type of operations, are already out there sailing, patrolling, flying and training on a daily basis. This should mean that there also are possibilities to train this in a smaller scale. But as many of these units do not have a large support unit, but are more or less self sustaining so to speak (e.g. the main SAR helicopter resource, the 330 Squadron; although being a military unit, they have very limited mission support capacity), the planning may have to be done at the SRU level. If acceptance for this is granted by higher authority, maybe on a general basis, then this type of *small scale procedural training* may actually be the solution to close the possible competence gap amongst many crew and JRCC operators in regards to large scale ACO operations. It is not realistic to be able to neither arrange more large scale exercises on a more frequent basis, nor is it realistic that the *number of* SAR crew and operators will be able to participate to a larger degree in the excisting exercises.

The need for formal education

Being a very rare occurence, large scale SAR operations *will* need to be trained and exercised, as previously discussed. But the formal theoretical education need also to be part of the picture. As an interviewee from the NoCG put it when being asked on the matter:

"Either we do it properly. Or we let go of the task. We can not do things halfway, it does not work that way."

The Norwegian Navy is according to written communication on the matter (Royal Norwegian Navy (RNoN), 2012), both eager and willing to take a leading role in the formal education. The section responsible for the education of HCOs, have concluded that this is within their capacity. Even though two SAR helicopter pilots during Exercise NORD 16 in

their written report made a remark where they underlined that the need for formal education is greater for the personell serving as ACO, they also underlined the need for training and exercise for every player. The solution to this might be that every ACO candidate receive the ACO theoretical course as a standard. And that representatives from SRU level receive the course on an ”availability basis”. So that every unit seen as a natural player in large scale SAR operations thereby have some formally educated persons to introduce this at unit level. This way the concept may not trigger a costly budgetary demand.

Conclusively there is a coherence between the need for both formal education, training and exercise in the field, and increase in operative performance between all participants in SAR-chan. In Exercise NORD 16, the pre-exercise meetings served as a sort of formal education of the units involved. With the same personell present at the meetings and on the day of the exercise, the units reported both increased flight safety and SAR effectiveness.

5.3 Increased operative performance from the ACO-role

The ACO-role is potentially a utterly *demanding* and also *enduring* one. Especially when one consider a worst case scenario. E.g. a ship with thousands of people sinking in arctic waters. My main research question was as follows:

How will a formal implementation of new ACO-procedures into the Norwegian SAR-service lead to increased operative performance from, and enhanced flight safety for, the aerial search and rescue units involved in a large scale search and rescue operation in the High North?

A tactical coordinator on the P3 Orion of the Norwegian Air Force makes an interesting and distinctive remark on the operative performance side of things while being interviewed:

”...stops being a search unit, to become a coordinating unit in demanding terrain, if it is needed in order to keep the communication.”

This sentence shows the demands on, and the complexity of, the role in several ways. First of all that the execution of the role might influence the *effectiveness of other tasks*. In this case the ability to function as a search unit. Demanding terrain might not be the case offshore, but it certaintly will be close to shore. In the waters around the islands of Svalbard, the most probable large scale scenario might be a passenger aircraft making an emergency landing on the polar ice, or a cruise ship running aground in the coastal waters of Spitsbergen.

Then terrain might also affect the ability to keep radio-communications towards a coordinating land unit, e.g. the tower at the airport in Longyearbyen.

In order for the ACO-role to provide for encreased operative performance from the SRUs, there are some very basic needs for ACO-personell that might limit this. A interviewee with experience from SAR-operations with the Coast Guard, put it this way:

"You need a bigger platform that is arranged for the task. One of the bigger ships. The operations under SkagEx 11 created a lot of noise (in the operations room onboard, my remark)*. Headsets were not in place."*

He mentions simple, but still critically important, factors that will affect the effective execution of the ACO-role. For the Exercise NORD 16, the headsets *were* in place. And the noise-level in the operations room was not mentioned in any of the feedbacks received from the ACO personell operating in the same room as the OSC personell. The evaluation report from the exercise SkagEx 11, where the ACO-role for the first time was tested in Norway, was inconclusive when assessing whether the setup of the ACO *and* OSC on the same plattform proved to be optimal. But the report is *not* inconclusive to the ACO role *itself,* and states:

"The ACO evaluator concludes that the ACO-procedures proved to work as intended; that flight safety was well maintained; and that the ACO´s coordination of SRUs was generally effective under the circumstances." (SkagEx11 Evaluation Report, 2012:39)

These conclusion very much coincide with both written evaluation reports from the acting ACOs, and my observations, during Exercise NORD 16. But some of the criticism of the ACO-role from SkagEx11, was also present at NORD 16. A very high workload was put upon the ACO, and the capacity of the helicopters was therefore not used to the full extent. In both exercises helicopters were sent to holding, while important tasks were still not complete (e.g. people still in the water). One of the persons acting as ACO at the Exercise NORD 16, remarks in his written evaluation:

"My focus was on flight safety over effectiveness. I am uncertain as to how the ACO contributed to increasing the effectiveness, but I would think that the coordination made it possible for the aerial units to focus on solving their mission". (Authors translation).

One of the helicopter pilots of NORD 16 also had a mentioning on this subject:

"At some point we were prioritized from searching for persons in the sea, and sent to holding in Saltfjorden. Timewise, we could have completed the search". (Authors translation).

This points to the possible contradiction in operative performance between flight safety and effectiveness.

Nevertheless, almost all of my data in fact contradict this *possible contradiction.* The survey was conclusive (22 out of 23) that *both* efficiency and flight safety would benefit from an ACO. My observations and feedbacks from Exercise NORD 16 is also conclusive in this regard. Although flight safety was emphasizes as a *main concern* (especially from the ACOs), operative effectiveness was also highlighted as an effect of the ACO role.

As earlier concluded, the ACO procedures fit the High North aspect to a great extent. The coherence between the ACO role and increased operative performance, in the light of how my main research question is expressed, is therefore *strong*. All empirical data points to this. Of course the High North poses some serious challenges in regards to remoteness, vast distances and climate, as discussed.

When it comes to flight safety, all my data show that the ACO role will definitely lead to increased flight safety for the SRUs involved. In the High North, the SAR helicopters are used to operating up to more than 200 nm out to sea. Often without anything other than either a unstable high frequency connection, or a more or less unreadable satellitte communication to rely on. With this in mind, the mere possibility of having a relay station overhead (e.g. the P3 fixed wing), will be a considerable strengthening of flight safety.

Conclusively, operative performance being defined in my thesis as a product of effectiveness and flight safety, the ACO role and the new procedure regime around it, will strengthen the Norwegian SAR system´s ability to perform large scale SAR operations in the High North.

6 Conclusive remarks

It is not a matter of *"if"*, but rather a matter of *"when"*, a worst case scenario SAR operation will have to be conducted in the Arctic waters of the High North. In the Norwegian SRR, the initial SAR resources will consist of Norwegian and most likely Russian units. The exchange in terms of valid ACO procedural training from the annual Exercise Barents between Norway and Russia, has been limited.

The ACO procedures fit the High North aspect in many respects. The only two capable ACO candidates in the Norwegian SAR structure, the larger ships of the NoCG and the P3 Orion MPA fixed-wing aircraft of the 333 Squadron, undertake their primary and daily tasks right in the middle of the High North part of Norwegian SSR, so to speak. The civil-military cooperation remain the only constellation capable of undertaking such a complicated task as a large scale SAR operation.

A sort of an ideal set up for the ACO procedures could be illustrated by the following mental picture: the P3 initially searching for, and then arriving at, the distressed vessel with their SKAD (Survival Kit Air Droppable), ahead of SRU units in the form of helicopters and ships. After having established the procedures in close cooperation with the JRCC North, they accept the role as ACO, and maintain this as long as they are able to endurance-wise. A NoCG ship steaming towards the area is then given the time to prepare for the task, and is given a thorough handover from the P3, in due time for it to return for refueling. The CG ship then has both the endurance, manning and capacities in the form of radar and HCOs on board, to attend to the task in the best possible way. They can even provide the SRUs (helicopters) with so-called helicopter-in-flight-refueling (HIFR). This best-case-scenario can most likely paradoxically enough, only be obtained in the High North sphere. Simple because the helicopter carrying CG ships and the MPA has their area of operation there.

For the JRCC to be able to communicate effectively with the ACO in the form of a CG ship or the MPA, there is still some work to be done. Up untill this has improved, the JRCCs ability to make timely decisions based on updated information and situation awareness, is hampered. A chat-type system being tested and developed towards the CG, may prove remedial to this shortcoming. As should the expected success of a project on securing broadband for the CG in the High North.

Even though the technicality of communication still poses some challenges, the lines of communication are firmly established. The ACO as a direct and effective subordinate to

the JRCC is indisputable. Recent years exercises have brought ascertainty to this relationship. As they have towards the OSC-ACO relationship.

In terms of training and exercise, it is my firm belief that this have to be altered to some extent. This being a field of expertise relying heavily on practical- and individual-type of competence, the Exercise Barents in itself is not providing nearly *enough* training for neither ACO candidates nor the desirable number of SRU crew. Lessons learned from these exercises (and the *Maksim Gorkiy*-incident), is that the interplay between Norwegian and Russian ACOs and SRUs is not very effective. My conclusion is that, in order for the Norwegian SAR system to fulfill its commitment towards the new IAMSAR manual, there is a need to conduct more frequent and smaller scale exercises in the form of procedural ACO training.

This should not in any sense be seen as a criticism on the ACO training being a part of Exercise Barents. Quite the contrary, in fact. The successfull coordination of Russian and Norwegian SRUs, by either a Norwegian or Russian ACO, in the Exercise Barents scenario, should be seen as the ultimate goal to fulfilling our common international commitments. But in the meantime, the Norwegian SAR system should make sure that ACO procedures are well attended to at all levels within their own system.

After having established an aduquate level of competence on ACO procedures and conduct, from operational to tactical level, a national exercise some place out to sea in the High North, should be seen as the ultimate examination on whether the ACO procedures have been thoroughly implemented into the Norwegian SAR system. And even if the system does not get all the way there, a lot of competence will be gained in the striving for this.

The conduct of a MRO or large scale SAR operation, in a highly dynamic and stressfull invironment, might be about the most complex task a SAR system can encounter, and still be expected to cope with. Whether the Norwegian SAR system will take full advantage of the possibilities the ACO procedures may provide, remains to be seen. But the worst case task of conducting a large scale SAR operation in the High North, rests with the Norwegian SAR system no matter what measures are taken beforehand.

And the seriousness of the task remains the same. As an official of the Coast Guard Centre of Competence put it:

”We are talking about saving lives. It is the most important thing we do”.

7 Limitations and recommendations for further studies

I have earlier mentioned that I was worried gathering data in Norwegian (e.g. all the interviews), and writing in English, could mean that important aspects would get lost in translation. In the end I did not feel that was the case. In some ways it even made especially the writing easier. The topic being in an *international sphere,* so to speak, with most of the professional terminology in English anyway, would have made it impossible to avoid a strong mix of English expressions in the text. This also lead to my decision *not* to transcribe interviews word by word. In some ways this made the data easier to interprete, code and categorize. This may by some be seen as a simplification and a limitation to this thesis. I feel the nature of the subject, and the professional language in use, contradicts this in a sufficient manner.

As I gathered data on the subject, it soon became clear to my that my contact network was to a great extent in the military sphere. The thesis would have benefitted from more empiri from civilan units in the SAR system. Both personell at oil rigs, and especially personell amongst the civilian SAR helicopter community at Svalbard, should ideally have been part ot the empiri to a greater extent. This may have been given a broader perspective to the thesis. But in planning the Exercise NORD 16, and through reviewing SARiNOR reports and a master thesis by one of the pilots at Svalbard (Hagen, 2013), I feel the ”civilian view” was to some extent duly accounted for.

With this in mind, I would still argue that in relation to ACO procedures and roles, the civil-military cooperation between the JRCC, the Coast Guard and the P3 Orion MPA, in this thesis deserved the most attention. The relationship between the JRCC and the NJHQ, could have been highlighted to a greater extent. But for this I will refer to the excellent master thesis already written on this subject, by Ringen T. and Eriksen M. (2015).

As I started on this thesis, I had to ”kill some darlings”, as my supervisor likes to put it. The relationship between the ACO and the OSC would be one of these, and I think this subject would prove very interesting, both in a communicational and an organizational perspective. Indeed it would deserve a master thesis on its own.

The same goes for the civil-military cooperation at a *unit* level. In working with this thesis, and in meetings with the SAR community of the oil industry, I have experienced the same enthusiasm and passion towards SAR, whether being military or civilan. For the Norwegian Sar system, this is maybe the most important finding in working with my thesis.

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Appendices

Appendix 1: Interview guide (in Norwegian)

Semistrukturert dybdeintervju / fokusert intervju

Utvalg: Strategisk utvalg av informanter

Informèr om:

- Brukes kun i forbindelse med masteroppgave
- Anonymiseres
- Lydopptak
- Transkribering
- Noen spørsmål rundt dette før vi starter?

Problemstilling:

På hvilken måte vil en formell implementering av de nye ACO-prosedyrene i norsk redningstjeneste føre til økt effektivitet fra, og forbedret flysikkerhet for, de luftbårne søk- og redningsressursene involvert i store søk- og redningsoperasjoner i nordområdene?

To what extent will a formal implementation of new (Baltic) ACO-procedures into the norwegian SAR-service lead to increased efficiency from, and enhanced flight safety for, the aerial search and rescue units involved in a large scale search and rescue operation in the high north?

Delproblemstillinger:

Hvordan vil arktiske forhold kunne pålegge begrensninger på ACO-rollen, og hvilke begrensninger vil dette kunne ilegge både ACO og søke-ressurser?

Hvordan kan dagens kompetansegap ift ACO-rollen fylles, og av hvem?

How will the sometimes extreme conditions and the environment of the high north affect the ACO-role, and what limitations on the performance of both ACO and SRUs may this lead to?

How may todays competence gap regarding the ACO-role in the norwegian SAR-service be closed, and by whom?

Åpningsspørsmål/oppvarming:

1. Hvilken stilling/funksjon har du?
2. Hva er din profesjonelle bakgrunn (i arbeidslivet) før nåværende stilling?
3. Hvor mange år har du fungert i nåværende stilling?
4. Har du formell utdanning ift ACO-rollen eller OSC-rollen?
5. Har du operative erfaringer med ACO-rollen eller OSC-rollen?
    a. I øvelse?
    b. I skarpe hendelser?

Hoveddel/refleksjon:

2. Hva ser du som ACOs viktigste oppgaver?
3. I hvilken grad skiller ACO seg fra OSC-rollen?
4. Har du sett forbedringspotensiale ift styring av luftressurser i de øvelser/aksjoner du har erfaring fra? På hvilken måte?
5. Hvordan ser du på ansvars- og kommandoforholdet mellom ACO og OSC i de tilfeller der rollene er ivaretatt av forskjellige enheter?
6. Vil din enhet kunne ivareta ACO-rollen?
    a. Nødvendig personell?
    b. Kommunikasjon? (Hva mangler evt?)
7. Har din enhet de kommunikasjonssystemer som er nødvendige for å ivareta ACO-rollen?
    a. Hvis ikke, hva mangler for å kunne ivareta dette?

8. Vil din enhet ha tilstrekkelig *situasjonsforståelse* til å kunne koordinere og delta i koordinering rundt en ACO i nordområdene?

    a. Hvis ikke, hva er det som hindrer dette i dag?
    b. Hvordan kan dette oppnås i (nær) fremtid?

9. På hvilken måte ser du eller ser du ikke at innføring av ACO-rollen i norsk redningstjeneste vil kunne gi økt flysikkerhet og effektivitet i en søk og redningsaksjon med flere involverte luftenheter?

10. I hvilken grad er eksisterende trening og øvelser egnet til å ivareta det krav til kompetanse og kontinuitet som ACO-prosedyrene krever?

11. Er det etter din mening også behov for teoretisk trening og kursing i ACO i Norge?

Avrunding:

1. Hadde du forventet noen spørsmål som ikke har blitt stilt ila intervjuet?

2. Har du avslutningsvis noen tanker om emnet, noen ting du vil utdype?

3. Kan eventuell oppfølging/utdyping taes i etterkant hvis noe er uklart.

Takk for at du stilte opp!

Appendix 2: Survey

Survey regarding Aircraft Coordinator (ACO)

Background for the survey:

I am preparing for a masters degree in Safety and Readiness at the University of Nordland (Norway). As a Sea King commander for 10 years I am interested in the effects of introducing the ACO-role formally in the norwegian search and rescue service. Specifically seen in relation to possible mass rescue operations in the cold waters of the arctic.

This survey is anonymous and will only be used in relation to my masters degree, and the data will not be forwarded.

Any questions about the survey and its results may be directed to Lieutenant Remi Eirik Olsen, email: remolsen@mil.no, or phone: +47 41 22 22 85.

Survey

1. **What is your background? (more than one x if several backgrounds)**

   Rescue coordination centre ☐

   Fixed wing crew ☐

   Helicopter crew ☐

   Other:_____ ☐

2. **Has your country formally approved the ACO procedures?**

   Yes ☐

   No ☐

   In the process of doing so ☐

3. **Have you had any experience with ACO in either live SAR-operations or exercises?**

   Yes ☐

   No ☐

   Not ACO, but similar coordination of air units ☐

4. **Was the ACO-role to the better for the SAR-operation/exercise, or to the worse in your opinion?**

Better	☐
Worse	☐
No experience with ACO	☐

5. **What was the most important learning points in the SAR-operations/exercises where an ACO/aerial coordination were in effect? (more than one X possible)**

Every unit needs to be *fully aware* of the procedures	☐
Communication was difficult and made the operation less efficient	☐
The operation was made *less efficient* by the ACO procedures	☐
The operation was made *more efficient* by the ACO procedures	☐
No experience with ACO in operation or exercise	☐
Other, please specify;_____	

6. **How do you think an ACO *ideally* will affect SAR-operations with several aerial units involved?**
(Range all answers in 1 through 5, where 1=*not at all*, and 5=*significantly*)

	1	**2**	**3**	**4**	**5**
It increases efficiency	☐	☐	☐	☐	☐
It increases flight safety	☐	☐	☐	☐	☐
It complicates an operation	☐	☐	☐	☐	☐

7. **When will the ACO-role be *most* needed in your opinion?**
(Range all answers in 1 through 5, where 1=*not needed*, and 5=*imperative to the success of the operation*)

	1	**2**	**3**	**4**	**5**
In any operation involving more than one aircraft	☐	☐	☐	☐	☐
In large scale operations (MROs) over the sea	☐	☐	☐	☐	☐
In operations in-land (not at sea)	☐	☐	☐	☐	☐

8. **What agency/unit do you think will be fit to act as an ACO under different circumstances? (more than one X possible)**

RCC (Rescue Coordination Center) ☐

ATC (Air Traffic Control) ☐

Fixed wing aircraft ☐

Helicopter ☐

Larger civilian ship ☐

Any military ship ☐

Military ship with HCO (Helicopter control officer) ☐

Fixed structure (oil rig etc.) ☐

Other:_____ ☐

9. **Is your experience that your agency/colleagues are negative or positive to the implement of the ACO procedures?**

Very negative – Negative – Neither positive or negative – Positive – Very positive

☐ ☐ ☐ ☐ ☐

Thank you for your participation!

Appendix 3: Example of coding and categorysation

Variables - context	High North/Arctic B-Oil-rig (development towards the north will mean more resources, also as ACO)	IAMSAR-prosedyrer B-"common platform gives us a back-pocket plan to effectuate. Less need for coordination."	Large scale SAR-incidents	SAR-system B-"..procedures will bring Norwegian resourses closer to each other." B-"..based on meetings at the JRCC – many different interests."
Variables – dependent and independent	ACO-role B-"..two-man-job."	Competence-training, exercise B-Smaller procedural exercises vs large scale	Operative performance	Effectiveness vs flight safety B-"..can see no negative effects of the procedures. Maybe profecion-fighting?" B-"procedures/instructions must be followed – if modified ACO must be informed."
Theoretical perspectives	Situational awareness B-procedure are based on radio and a log. Radar gives a better SA. B-in coastal waters – aerial platform more essential.	High reliability organisations B-focus on details – new rescue helicopter not equipped for ship landings (lacks deck-lock system)	Decision making	Improvisation
Thesis/research Qs	ACO-role vs flight safety/effectiveness B-ACO/OSC co-located. B-"ACO different from OSC in dimension/speed/safety-aspect" B-what is safe is dependent of the situation	Procedures vs need for training/exercise B-implementation wil not demand to much resources (economical) B-complicity. HCO not receptive early in their education. Need some experience. B-"We are overdue (in time). Must have this in place. Training and people. get the system in place."	High North effect on procedures/improvisation B-helicopters at Svalbard trained with Coast Guard B-Forward Operating Bases B-RU-w/o X-ponder B-RU-unit acting as ACO? B-procedures suitable over land as well	