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FFI-REPORT

Multinational search and rescue in the Arctic

– findings from a concept development assessment game

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Summary

The Norwegian Defence Research Establishment (FFI) facilitated a three-day concept development assessment game (CDAG) in Oslo, October 15–17, 2024. FFI conducted the game to support the multinational project Climate change in the Arctic: Security implications and consequences for military operations (CLIMARCSEC), which develops a conceptual framework to help military planners better conduct, align, and deploy resources in future multinational force operations in the Arctic.

The primary purpose of the Oslo CDAG was to provide results for a report on the implications of climate change for search and rescue (SAR). The game used scenarios which described hypothetical SAR missions in the Arctic. A total of 15 international participants took part in the game, playing as two operational teams which developed simple courses of action and plans for the possible SAR response within the scenarios. By comparing plans made by the two teams, the participants were able to identify several challenges that military planners must consider for missions in the Arctic.

Search and rescue in the Arctic may seem well regulated through international agreements, where SAR is treated as a national responsibility within pre-defined geographical regions. However, the Arctic is a huge area, and rescue resources are limited and thinly spread. Thus, the practical conduct of SAR will often be multinational, based on whatever resources are near the mission area. Participating units may be both civilian and military, which adds to the challenge of sharing information and coordinating operations.

Through plenary discussions, the participants identified possible recommendations and solutions to address some of the challenges. We have analysed these recommendations and grouped them into four categories:

1. ensuring international and civil-military collaboration
2. developing relevant multinational planning products and operational tools
3. conducting more multinational exercises and training
4. linking multinational SAR operations to guidance from higher-order military concepts

This report is not a comprehensive functional concept to guide multinational SAR in the Arctic. However, it provides relevant guidance if such a concept is to be developed. Additionally, the report gives valuable input to future scenario-based analyses of SAR capabilities and solutions through the description of courses of action, tasks, and challenges.

Sammendrag

Forsvarets forskningsinstitutt gjennomførte et tredagers konseptutviklingsspill for det flernasjonale prosjektet Climate change in the Arctic: Security implications and consequences for military operations (CLIMARCSEC) i Oslo 15.–17. oktober 2024. CLIMARCSEC lager et konseptuelt rammeverk som skal støtte militære planleggere under framtidige flernasjonale operasjoner i Arktis.

Formålet med Oslo-spillet var å gi resultater til en rapport om konsekvensene av klimaendringer for søk og redning i Arktis. Spillet brukte scenarioer som beskrev hypotetiske oppdrag med søk og redning i regionen. 15 internasjonale eksperter deltok i spillet, og de spilte som to operasjonelle plangrupper som lagde enkle handlemåter og planer for søk og redning innenfor scenarioene. De identifiserte også flere utfordringer som militære planleggere må vurdere under operasjoner i Arktis.

Søk og redning i Arktis er i utgangspunktet et nasjonalt ansvar innenfor definerte geografiske sektorer, i henhold til internasjonale avtaler. Samtidig er Arktis et stort område med få tilgjengelige redningsressurser. Derfor blir mange oppdrag innen søk og redning i regionen i praksis flernasjonale, basert på hvilke ressurser som er tilgjengelig nær oppdragsområdet. Redningsressursene kan være både sivile og militære, noe som gir flere utfordringer for koordinering og informasjonsdeling mellom deltakerne.

Spilldeltakerne kom med flere anbefalinger og forslag til løsninger for å håndtere disse utfordringene. I rapporten har vi gruppert disse anbefalingene i fire hovedkategorier:

1. legge til rette for internasjonalt og sivilmilitært samarbeid
2. lage relevante flernasjonale planprodukter og operative verktøy
3. gjennomføre mer flernasjonal øving og trening
4. koble planlegging av flernasjonale søke- og redningsaksjoner til føringer fra strategiske militære konsepter

Denne rapporten beskriver ikke et fullstendig funksjonelt konsept for flernasjonale søke- og redningsaksjoner i Arktis, men den inneholder mange resultater som er relevante dersom et slikt konsept skal lages. I tillegg er beskrivelsen av framgangsmåter, planer og utfordringer nyttig for framtidige scenariobaserte analyser av nødvendige kapabiliteter for søk og redning.

Contents

1 Introduction

The Norwegian Defence Research Establishment (FFI) facilitated a three-day concept development assessment game (CDAG) for the MCDC[1] project CLIMARSEC[2] in Oslo, October 15–17, 2024. CLIMARCSEC considers the security implications of climate change in the Arctic, not least for military operations with multinational forces (MNF) [1]. The project deliverables include a report/conceptual framework to help military planners better conduct, align and deploy resources in future MNF operations in the Arctic. Within this general scope, the project looks specifically at possible implications for search and rescue (SAR) in the Arctic.

The goals of the Oslo CDAG were to:

1. assess the utility of parts of the draft CLIMARCSEC concept

2. develop a separate chapter/report with relevant guidance for MNF planners on SAR in the Arctic

3. develop and share knowledge, by letting expertise across nations meet and share insights and best practices

The CDAG benefited from the expertise of 15 participants from both sides of the Atlantic, including search and rescue planners and practitioners, military officers, policy developers, researchers, and parts of the CLIMARCSEC writing team.

This report is the deliverable covering goal 2 in the list above. It gives a short overview of the main topics covered in the CDAG, and it identifies some recommendations and possible solutions to consider for the future planning of MNF SAR in the Arctic. The report is written as a possible appendix in the final CLIMARCSEC report, with free use of any relevant results within the main body as well.

To help integrate the results from our report into the CLIMARCSEC final report, we have purposefully kept the main body short and to the point, with more details available in appendices. The appendices include more details about the following: A) MCDC and the CLIMARCSEC project, B) the CDAG format, C) scenario descriptions from the CDAG, and D) courses of action for and challenges when solving the tasks within some of the scenarios.

[1] MCDC = Multinational Capability Development Campaign.
[2] CLIMARCSEC = Climate change in the Arctic: Security implications and consequences for military operations.

2 Findings from the CDAG

2.1 Multinational SAR in the Arctic: Who and what?

The CDAG participants pointed out that SAR in the Arctic in principle is a national responsibility, following the guidance from international agreements. Two key agreements are:

- The International Aeronautical and Maritime Search and Rescue (IAMSAR) Manual, which provides comprehensive guidelines for organizing and conducting search and rescue operations worldwide [2].

- The Arctic Council's Search and Rescue Agreement, formally known as the Agreement on Cooperation on Aeronautical and Maritime Search and Rescue in the Arctic. This agreement assigns each Arctic state a specific SAR sector, where they are responsible for conducting search and rescue operations [3].

A SAR operation is usually led by a national joint rescue coordination centre (JRCC), which might be civilian or military, depending on different national practices. Many national systems are guided by the IAMSAR Manual. It is important to note that while there are overall agreements and treaties in place on the national level between the Arctic countries, the cooperation may be less developed on the operational level.

Given that SAR in principle is a national responsibility, the participants discussed what the multinational force aspects of SAR could be. One key factor is that while the conduct of SAR is a national responsibility, available resources for SAR in the Arctic are limited. Individual nations are unlikely to have sufficient SAR resources within their sectors of responsibility, especially given the foreseen activity levels in the Arctic following the effects of climate change.[3] Thus, many SAR missions will need a multinational response to ensure sufficient and timely rescue resources. Possible MNF for SAR can be categorized in two groups:

- Ad hoc MNF. Units that are available near, or can be deployed into, a mission area are organized into an ad hoc task force, supporting the national JRCC.

- MNF already organized within existing command and control arrangements. They can be diverted to support the national JRCC. Examples are the Standing NATO Maritime Groups (SNMG), or forces participating in multinational live exercises like Trident Juncture or Operation Nanook.

[3] Additionally, given climate change and the current security situation, military presence in the Arctic is expected to increase. This may lead to accidents with military vessels or platforms, which in turn will need rescue operations.

Following this, the participants discussed which planners would need guidance on SAR:

- policy developers doing long-term planning and development of SAR systems and structures
- operational planners who plan, prepare for, lead or support SAR operations

2.2 The Arctic SAR challenge: Scenarios

2.2.1 The future challenge: Scenario/risk matrix

Both long-term and short-term planners need an overview of the possible future SAR challenges in the Arctic. The CLIMARSEC project addresses this by describing both the current operational environment and possible future developments due to climate change. For the latter part, the project has developed a risk matrix, spanning the width of possible factors relevant for Arctic SAR.

A draft version of the matrix, shown in table 2.1, was assessed during the CDAG. The participants considered the uses of the matrix and possible changes/improvements, see appendix B for detailed suggestions. Once finalized, the matrix is a valuable contribution from the CLIMARCSEC work, since it is a useful tool for several planning purposes:

- supporting development of relevant scenarios for training, exercises, and planning of future SAR capabilities and solutions
- providing a check list of relevant risks factors to consider for the planning and conduct of specific SAR missions

Table 2.1 Example scenario/risk matrix. Explanations of the acronyms and hull classifications used can be found in the Acronyms section below.

Parties	Civ/mil.	Terrain/ domain	Season	Impaired platform	Unique challenges	# affected/ evacuated
Blue	Civilian	Mountains	Spring	Ship (commercial, tourism, military)	CBRN/pollutants	<50
Red	Military	Land	Summer	Unmanned vehicle (aerial, surface, underwater,)	Wildlife	<150
Neutral	Non-gov.	Littoral	Autumn	Research/ISTAR equipment (research institute, government research, military)	Degraded ISR	>150
		Oceans	Winter	Rotary wing (air attack, air control, ISR, air mobility)	Private mil. companies	
		Riverine		Fixed wing (air attack, air control, ISR, air mobility)	SAR assets bound in concurrent ops.	
		Swamp		Submarine (SSN, SSK, SSG/SSGN, SSBN)	International SAR effort	
				Oil/gas platform	Allied-only SAR effort	
				Renewable energy	Access issues (weather, terrain)	
				Natural resource extraction	Security situation (stable/ competitive, crisis)	

2.2.2 Cases: Example scenarios

Most of the work during the CDAG used scenarios, which were short descriptions of SAR missions in the Arctic. We brought five scenario outlines to the CDAG, and the participants assessed the outlines and suggested changes to make them more relevant. The changes included:

- introducing geography and challenges relevant for both the European Arctic and the North American Arctic
- including more operational details to highlight a variety of SAR challenges. Changes included: different ice conditions at sea, SAR near areas of dispute between nations, SAR involving multinational responses on land, and scenarios involving search after platforms or groups of people with unknown location.
- fixing errors or inconsistencies

This initial quality assurance helped the initial problem scoping for the CDAG. It ensured that the participants had a similar understanding of the challenges before the scenarios were used in the latter parts of the game. We assess that this helped utilize the SAR expertise present in a good way, by giving a robust basis for the later scenario discussions.

The resulting scenarios are shown in appendix C, describing the following challenges:

1. a cruise ship with 2,000 passengers/crew drifting in icy waters after engine failure
2. a submarine leaking after a collision
3. evacuation from an oil rig
4. two helicopters missing over land, in the border area between three countries
5. missing groups of people, either snowmobile patrols or hunter parties, in one case near an area of dispute between two countries

Additional scenario ideas were also considered, not least more competitive and conflict-oriented scenarios. Suggestions included SAR in a contested area or involving an adversary, or collisions between adversarial warships.

2.3 Courses of Action and challenges

For the remainder of the CDAG, the participants worked in teams within a selection of the scenarios above. Both teams considered a variation of scenario 1 (cruise ship). Team 1 also considered scenario 4 (missing helicopters), while Team 2 considered scenario 5 (missing people).

The teams were asked to suggest courses of action (COA) with relevant tasks within the scenarios, along with a simplified plan to manage the scenarios. Within the identified COA, they were also asked to identify possible challenges related to SAR capability in the Arctic.

The COA work enabled the participants to identify specific tasks for an MNF conducting or supporting SAR in the Arctic. Many of these tasks are valid for all types of military operations in the Arctic, and this is also true for the identified challenges within the different COA. The detailed COA and the plans for the three scenarios are presented in appendix C. Here, we give a short overview of the main findings.

2.3.1 Generic SAR COA

Most search and rescue missions will follow standard courses of action, with the following generic tasks:

- Decide on the responsible nation and joint rescue coordination centre, according to established command and control agreements.
- Get information on the status of the missing persons/platforms.
- Assemble and deploy sufficient rescue resources for the mission. This includes getting an overview of relevant infrastructure and bases to support the mission.
- Search for and locate the impaired persons and platforms.
- Secure the impaired platforms, to prevent worst-case health scenarios, environmental damage and loss of platform.
- Provide help to impaired persons on-site, including supplies and medical treatment.
- Evacuate impaired persons when possible and needed.
- Manage public relations and media throughout the mission.

While this sounds simple enough, the participants discussed several challenges for doing this within the scenarios. Some of these challenges are discussed in more detail below.

2.3.2 Command and control

As discussed earlier in the report, the general principle for command and control (C2) of SAR is a national responsibility. In the Arctic, national responsibilities follow sectors as defined in the Arctic Council agreement on SAR [3]. However, there are certain cases where the principled solution may be less clear-cut in practice:

- missions near national border areas on land, or at the sector borders at sea
- missions in or near areas of dispute

In most cases, C2 is still decided through existing agreements or practices, like letting the "last known position" of the impaired persons or platforms guide which JRCC is in charge. However, as the mission develops, there may be a need for dynamic updates to C2 arrangements.

2.3.3 Secure sufficient and timely resources and infrastructure

Perhaps the biggest challenge for SAR in the Arctic is to secure sufficient resources and infrastructure to support large, urgent missions. The Arctic is a huge area with little available infrastructure. Dedicated rescue resources, including SAR helicopters, icebreakers and tugs, are relatively few and spread out.

Thus, many SAR missions will depend on support from whichever vessels, aircraft, or land units are available near the mission area. While the conduct of SAR is a national responsibility, the response must often be multinational. The full MNF response may include civilian and military resources, federal and local resources, and experts and trained operators as well as volunteers. This may also involve resources that are not fully trained or optimized for search and rescue in challenging environments: Personnel and platforms with varying levels of experience, training, capacity, and quality of cold weather gear and equipment.

2.3.4 Information requirements

A SAR mission leads to huge information requirements, including:

- status of impaired platform, including last known location, condition, damages, environmental hazards, and danger of pollution
- status of impaired persons, including last known location, level of experience, supplies and equipment, and condition/medical status
- sense of urgency, including whether evacuation needs to start immediately, or whether impaired persons can be sustained on-site over time
- available resources, equipment and infrastructure for supporting the mission, including current location, capacity, and any restrictions/caveats for use
- weather, local conditions, and hazards in the operational area

Collecting and sharing this information with all involved parties in the mission may be challenging, due to scarce communication capabilities in the Arctic, less developed collaboration practices on the operational and tactical level, and a lack of interoperability

between involved parties. The interoperability issue is particularly challenging in case not all involved nations use NATO standards.

2.3.5 Search and rescue conduct

Even if resources are available and the general information requirements are covered, there are still many challenges for successful MNF SAR in the Arctic. Some of these include:

- The situation on-site may deteriorate over time and change the urgency of the mission, for instance due to damages to the platforms, supplies running out, and changing medical conditions of impaired persons.
- Weather and climate conditions may hamper the use of certain capabilities, for instance use of helicopters in bad weather. This may delay the search for personnel or platforms with unknown locations.
- Necessary tools, charts, or flow models may not be updated following changes to the climate, hindering an effective response.
- Response or deployment times of relevant resources may be lengthy, due to long distances to the mission area.
- The mission may be hampered by weak communication systems in the mission area.
- Massive media attention or political interest may influence on the conduct of high-profile SAR missions.
- Local risks or hazards may need personnel with special equipment and training.
- Civil and military resources and responders may not be interoperable, due to different practices, terminology, standards, training, equipment, etc.

2.4 Recommendations

Based on the challenges identified in chapter 2.3, the CDAG participants suggested possible recommendations for MNF SAR in the Arctic. After the game, FFI analysed the results and grouped the recommendations into the four categories below. Thus, the following results are FFI's interpretation of the findings from the CDAG.

2.4.1 Ensuring international and civil-military collaboration

Efficient search and rescue hinges on cooperation between a variety of actors and nations, integration of services (both civil and military), coordination of efforts, and agreed-upon responsibilities for managing the crisis. Given the likely need for a multinational response to

SAR missions in the Arctic, international collaboration is critical to develop relevant capabilities and practices further. Some aspects of this are:

- Consider the need for revisions of existing SAR agreements and guidelines, to ensure that they are relevant and sufficient for the likely increase in SAR missions following Arctic climate change.

- Host symposia and annual meetings on SAR, to raise awareness, share experiences, develop best practices, and establish networks. Possible participants are civilian and military SAR authorities, military and civilian planners and operators, and commercial actors and industry operating in the Arctic.

- Consider crossover findings between SAR in the Arctic and the Antarctic.

Part of this collaboration will involve private actors, not least to share information on the risks and best practices for operating in the Arctic. It is important to manage the expectations of commercial operators on the levels of SAR support that may be available, so they can increase their own robustness and self-sufficiency: conducting survival training and exercises, reducing vulnerability by sailing ships together in pairs, boosting own supplies and medical capabilities, etc.

As well as international cooperation, there is a need for civil-military cooperation (CIMIC). In addition to the suggestions for international collaboration above, considerations for CIMIC cooperation are:

- Develop NATO directives/guidelines for CIMIC cooperation in non-combat operations (for instance, SAR). This should include how an MNF can plug into the existing IAMSAR framework.

- Ensure that SAR mission C2 is understood and accepted, including that a MNF may have to give unit tactical control over to the civilian JRCC.

- While the current NATO C2 structure may not be appropriate to tackle SAR operations, a standing NATO HQ could be developed with more responsibilities to conduct SAR.

2.4.2 Developing relevant MNF planning products and operational tools

Given that a SAR-supporting MNF may include actors from non-Arctic states or resources with little operational experience from Arctic conditions, there is a need for both supportive planning products and updated operational tools. Some relevant products/tools include:

- a standardized terminology related to SAR in the Arctic, for instance lexicons of common terms and definitions

- a regularly updated international SAR database, with overview over regulations, agreements, responsibilities, JRCCs, resources, contact information, etc.

- a comprehensive preparation of the operational environment (CPOE) of the Arctic, as a basis for operational planning

- updated charts, seabed maps and flow model inputs, to address changes as the ice melts and more of the Arctic opens up

- easily shared maritime pictures and common operating pictures, to support the conduct of specific SAR missions[4]

- a future risk assessment of the Arctic based on plausible trends, with possible "hot spots": where are the most relevant risks when the operational area changes? This analysis can help guide development of relevant future capabilities and solutions.

2.4.3 Conducting more MNF exercises and training

Exercises and training can address several of the gaps discussed in chapter 2.3:

- Conduct table-top exercises in international fora, to explore issues related to future Arctic SAR. Some things to consider are whether existing agreements and guidelines are sufficient, what the expectations for SAR responsibilities among the Arctic nations should be in the future, how we can future-proof SAR responses to plausible future challenges, and how we can manage possible mass-casualty scenarios.

- Functional SAR exercises on worst-case scenarios, for instance how to support many impaired persons over time inside the mission area, or how to conduct mass rescue (including medical treatment). The exercises may also include practical training on C2, information sharing, interoperability, and cold weather operations.

- More exercising and training of cold-weather operations in general.

2.4.4 Linking MNF SAR operations to higher-order concepts:

CLIMARCSEC has an ambition to link the project findings to higher-order military concepts, like the NATO Warfighting Capstone Concept [4] and the US Joint Warfighting Concept [5]. It is important to note that search and rescue is not a warfighting operation, nor is it necessarily a military responsibility. However, it is still possible to link aspects of SAR to key tenets in the higher-order concepts. Using tenets from the US Joint Warfighting Concept as an example, some relevant implications for MNF SAR in the Arctic are:

[4] For instance, a civilian JRCC might want a "military picture" of military resources that can be utilized in the rescue operation.

- Integrated command and agile control
    - Use established C2 practices: One nation is in the lead, supported by MNF resources when available.
    - Enable civil-military collaboration and integration relevant for SAR.
    - Establish shared civil-military and MNF situational awareness.
    - Ensure interoperability and the ability to conduct operations together, both civil-military and within an MNF.
- Integrated, combined joint force with allies and partners
    - Enable sharing of information and resources, civil-military and within an MNF.
    - Consider the importance of space and sub-surface domains in the Arctic.
    - Non-Arctic nations may be able to offer support from special forces, trained to operate in harsh climates.
- Expanded manoeuvre, resilient logistics
    - Develop resources able to access and operate in remote, challenging Arctic areas.
    - Develop infrastructure and resources necessary to sustain the SAR operations.
    - Develop cold weather adapted equipment, and train personnel for cold weather operations.
    - Secure the ability to operate in contested areas.
- Pulsed operations, global fires
    - Continuity might be more relevant than “pulsed” for SAR. However, if “pulsed” means being able to concentrate forces, this is certainly relevant for MNF SAR.
- Information advantages
    - Enable sharing of information and develop sufficient knowledge about the Artic operational environment.

Related to this, it is possible to view a robust SAR capability as an important tool for a nation to demonstrate its sovereignty, by appearing as a credible, trustworthy nation in the Arctic. Thus,

SAR is a reason to have a military presence in the area. This also leads into tenets from the NATO Warfighting Capstone Concept.

3 Conclusions

The CDAG received good feedback from the participants. Several participants mentioned that it was particularly useful to discuss with others with a variety of responsibilities, experiences and backgrounds, from both the strategic and operational/tactic level, from both sides of the Atlantic.

The CDAG helped assess ideas and products within the CLIMARCSEC work. The initial problem scoping on the *who* and *what* of MNF SAR was particularly useful, as it helped develop more insights into the multinational aspects of Arctic SAR. The scenario discussions made it possible to identify recommendations for future SAR in the Arctic, given the impact of climate change in the region.

It must be noted that several relevant topics were not covered during the CDAG:

- more scenarios, including scenarios with pollution, environmental damage, and adversarial SAR
- more discussion on SAR as a political and military tool, for instance as a reason to have a military presence in the Arctic
- more on the interests and influence on SAR of indigenous people, non-Arctic nations, and private actors

Thus, the recommendations in chapter 2.4 will likely benefit from further quality control and analysis.

This report is not a meant as a comprehensive functional concept to guide MNF SAR in the Arctic. However, it provides partial guidance that is relevant for any future development of such a concept. Additionally, it gives valuable input to scenario-based analysis of future SAR capabilities and solutions, through the description of COA, tasks and challenges.

Acronyms

AMVER	Automated Mutual-Assistance Vessel Rescue
C2	Command and Control
CBRN	Chemical, Biological, Radiological, Nuclear
CDAG	Concept Development Assessment Game
CIMIC	Civil-Military Cooperation
COA	Course(s) of Action
CPOE	Comprehensive Preparation of the Operational Environment
CLIMARCSEC	Climate change in the Arctic: Security implications and consequences for military operations
FFI	Forsvarets forskningsinstitutt
HQ	Headquarters
IAMSAR	International Aeronautical and Maritime Search and Rescue
ISR	Intelligence, Surveillance, and Reconnaissance
ISTAR	Intelligence, Surveillance, Target acquisition, and Reconnaissance
JRCC	Joint Rescue Coordination Centre
MCDC	Multinational Capability Development Campaign
MEDEVAC	Medical Evacuation
MNF	Multinational Force
PMESII-PT	Political, Military, Economic, Social, Information, Infrastructure, Physical Environment, Time
PR	Public Relations
SAR	Search and Rescue
SNMG	Standing NATO Maritime Groups
SOF	Special Operating Forces
SSBN	Hull classification for nuclear-powered ballistic missile submarines
SSG(N)	Hull classification for guided-missile (nuclear-powered) submarines
SSK	Hull classification for diesel-electric hunter-killer submarines

SSN	Hull classification for nuclear-powered submarines
STRATEVAC	Strategic Evacuation

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Appendix

A MCDC and the CLIMARCSEC project

The Multinational Capability Development Campaign (MCDC) is an international collaboration program for the development of military capabilities and concepts. MCDC is led by Joint Staff, USA, and a total of 24 countries and international organizations collaborates within the program to develop and assess non-materiel force development solutions. Projects within MCDC are part of two-year campaign cycles.

CLIMARSEC is a multinational project under the MCDC umbrella, running through 2023–2024. The project is led by Norway: the Ministry of Defence, and the Norwegian Institute of International Affairs. CLIMARCSEC considers the security implications and consequences of climate change in the Arctic, not least for military operations with multinational forces (MNF) [1].

The planned main deliverable is a report, written as a multinational concept presenting the key findings from the project, including:

- an analysis of the current situation in the Arctic, due to climate change
- an overview of governance and capability gaps for MNF in the Arctic
- proposed solutions to overcome identified challenges/gaps and meet future requirements

This concept is to be developed with links to the NATO Warfighting Capstone Concept [4] and the US Joint Warfighting Concept [5], with some narrowing of scope:

- Focus more on crisis management in the Arctic, less on warfighting/force on force, not least due to the product being unclassified.
- Focus primarily on operational issues related to governance, command, control, communication, and coordination of MNF operations in the future Arctic, less on tactical problem-solving.

While CLIMARCSEC considers a range of military challenges and operations across the Arctic, a recurring challenge in the region is search and rescue (SAR). Given the likely increased relevancy of this challenge following climate change, the concept pays special attention to the case of SAR and related challenges in the Arctic theatre.

B The CDAG format

B.1 A typical CDAG

A concept development and assessment game (CDAG) is a technique for theoretical low-risk and low-cost testing of draft concepts, before they are tested or used in a live environment. A CDAG is a tabletop wargame designed to test different aspects of a concept, typically its usefulness, applicability, and completeness. The CDAG can also help identify parts of the concept that needs to be refined during finalization or developed further in future work.

The game is done in several rounds, which combine teamwork with plenary confrontation sessions in different phases. The conduct of a typical round is show in figure B.1

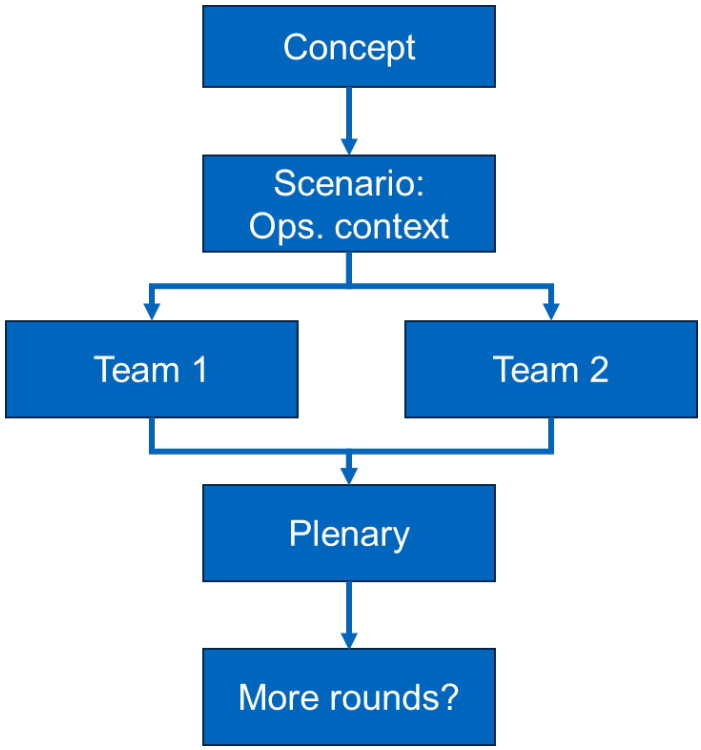

Figure B.1 A typical CDAG round.

Each round typically consists of four phases:

1. In-brief: The teams are introduced to their individual tasking for the round.

2. Planning/teamwork: The teams plan and solve their task, using (parts of) the concept to guide their work.

3. Plenary, with confrontation/challenge: The teams meet in plenary and present their findings, with clarifications between the teams. Additionally, a group of subject matter experts in areas relevant for the concept may be part of this plenary, challenging the groups on their findings and how the concept guided them in their work. This helps identify data on the various qualities of the concept.

4. Data collection: While data may be captured throughout all phases, a CDAG often allows for dedicated time slots between rounds, where participants can fill in surveys or be interviewed.

The CDAG typically uses scenarios which describe relevant operational situations. The scenarios allow for specific discussion and relevant testing of the concept. Additionally, the teams may be provided with concept cards or guidelines that will help them use the concept.

B.2 The Oslo SAR CDAG

SAR was included as a case for CLIMARCSEC in the spring of 2024. FFI also used a SAR scenario in a one-day test CDAG for the project team in February 2024 [6].

Thus, the Oslo CDAG on October 15–17 was designed to help flesh out SAR considerations for the project work. The CDAG results led to a self-standing report on SAR in the Arctic, which can serve as an appendix to the CLIMARCSEC final report.

The CDAG schedule was as follows:

- Tuesday October 15: **Introduction and problem scoping**
    - In-brief, with an introduction to the problem
    - Information on current SAR efforts in the Arctic, by the Norwegian Coast Guard
    - Problem scoping:
        - What is MNF operational planning: Users and uses?
        - SAR in the Arctic: Quality control of vignettes
- Wednesday October 16: **Planning**
    - Introduction to The Norwegian Defence Pledge and Arctic Security, by the Ministry of Defence
    - The game, with different scenarios describing Arctic SAR challenges

        - Discuss and develop operational COA/plans
        - Discuss and identify challenges and issues to the COA/plans, using PMESII-PT[5].

- Thursday October 17: **Recommendations**
    - Identify important findings and recommendations
    - Hot washup

The work on all days were a mix of teamwork and plenary discussions, following the typical conduct of a CDAG. Data collection was primarily done through work in slide templates during the teamwork and in the plenary discussions.

[5] PMESII-PT = Political, Military, Economic, Social, Information, Infrastructure, Physical Environment, Time. This is a tool to help assess operational environments.

C Scenarios

C.1 Risk/scenario matrix

Table C.1 Example risk/scenario matrix.

Parties	Civ/mil.	Terrain/ domain	Season	Impaired platform	Unique challenges	# affected/ evacuated
Blue	Civilian	Mountains	Spring	Ship (commercial, tourism, military)	CBRN/pollutants	<50
Red	Military	Land	Summer	Unmanned vehicle (aerial, surface, underwater,)	Wildlife	<150
Neutral	Non-gov.	Littoral	Autumn	Research/ISTAR equipment (research institute, government research, military)	Degraded ISR	>150
		Oceans	Winter	Rotary wing (air attack, air control, ISR, air mobility)	Private mil. companies	
		Riverine		Fixed wing (air attack, air control, ISR, air mobility)	SAR assets bound in concurrent ops.	
		Swamp		Submarine (SSN, SSK, SSG/SSGN, SSBN)	International SAR effort	
				Oil/gas platform	Allied-only SAR effort	
				Renewable energy	Access issues (weather, terrain)	
				Natural resource extraction	Security situation (stable/ competitive, crisis)	

Some of the suggested improvements to the matrix above were:

- Clarify who the “Parties” column covers, the rescuers or the rescued?
- Include “internal federal agencies” under “Civ/mil” column.
- Include columns for both “ice conditions and “aviation conditions”, since these factors have significant impact on how to conduct a SAR operation.
- Include more values under the column “Impaired platform”, including “underwater infrastructure”, “groups of people”, “commercial airline”, and “other”.
- Include more values under “Unique challenges”, including “media considerations”, “navigation degradation”, security situation “strategic” or “tactical/onsite”, and “other”.
- Consider the numbers under “# affected/evacuated”. A typical SAR mission involves less than five affected. Also, the numbers are of less importance than the combination of SAR resources needed and the urgency/time factor.
- Consider fleshing out the unique challenge “CBRN/pollutants”, by having it as a separate column with more detail.

C.2 Scenarios

These are the scenario slides shown during the game. References to used pictures are shown for the individual slides.

Scenario 1: Cruise ship adrift

- A cruise ship with 2000 pax is stuck in Norwegian territorial waters north of Svalbard
- The ship's engine has failed, and the ship is drifting in the ice, with no heating
- There are multiple nationalities among passengers
- The medical treatment capacity on Svalbard is limited
- Ice conditions:
  - A) Ship is drifting in marginal ice/slush
  - B) Ship is frozen in solid ice
- Changes:
  - Unlikely that heating has failed with Polar Class 4/5 vessels

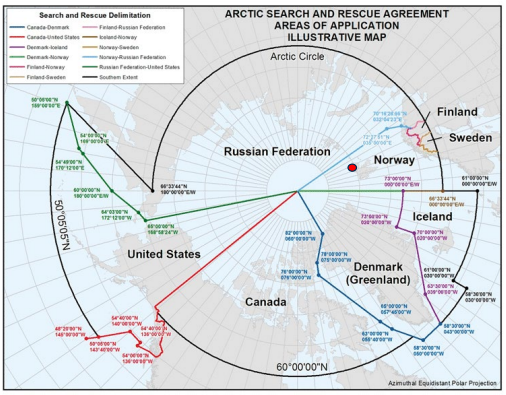

Figure: Wikipedia

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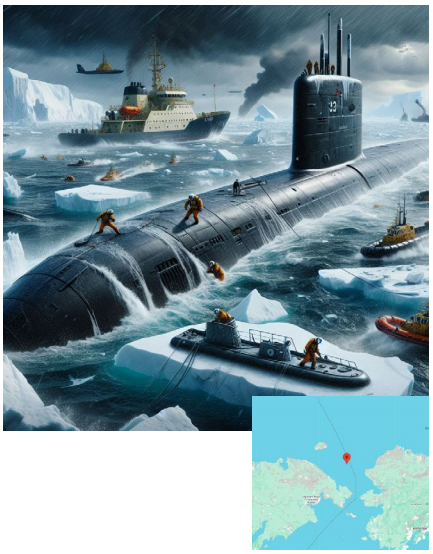
The SAR agreement area map is from Wikipedia [7].

Scenario 2: Submarine collision

- A nuclear allied submarine collides with an uncharted underwater iceberg. The impact causes significant damage to the submarine's hull and leads to flooding in several compartments
  - Alternatives: Change to Frigate? Non-nuclear sub?
- The submarine's emergency beacon is activated, providing a precise location for rescue teams in the Arctic Ocean, Chukchi Sea, American side, approximately 150 meters (492 feet) below the surface
  - Icebergs are unlikely in the Chukchi Sea. Alternative: Change to North Atlantic? Or collision with another vessel?
  - Interesting for Non-polar-classification vessels in the Arctic waters
- Extreme weather conditions + with high winds



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The submarine picture is made with Microsoft Copilot. The map is made with Google Maps.

Scenario 3:
Oil Rig Evacuation

- A severe storm leads to structural damage on an oil rig in the Arctic Ocean, with the risk of oil spill
- Emergency responders must evacuate the rig's 200 personnel and contain the potential environmental disaster
- Land-based helicopters are not able to operate due to icing on shore

Possible locations:

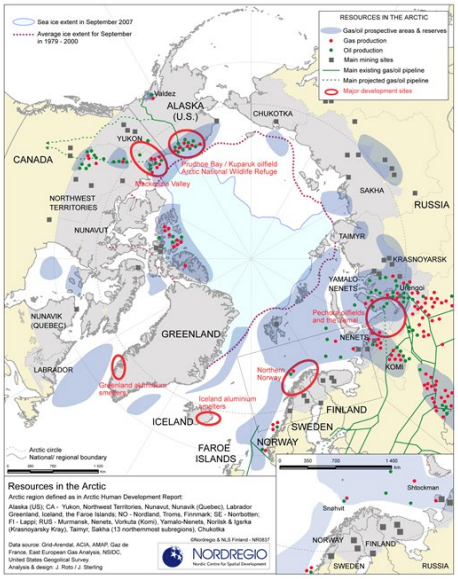
Beaufort Sea: This area includes the North Slope of Alaska and the Mackenzie Delta in Canada.

Barents Sea: Located off the northwest coast of Russia, this sea is a major site for oil exploration.

Pechora Sea: Also in the Russian Arctic, the Prirazlomnoye oil field is an example of drilling in this region.

Norwegian Sea: Near where it meets the Barents Sea, the Goliat oil field is a significant site.

Canadian Arctic Archipelago: This includes regions like Nunavut, which are also linked to oil and gas exploitation



The resources map is from Nordregio [8].

Scenario 4:
Black Hawks down

- Two Black Hawks disappears in the winter snow in Finland. They were operating from Bardufoss military base
- Comms were lost after departure, but their mission was to support Norwegian army manoeuvring in the Swedish/Finnish border areas
- Helos did not appear on any radars due to flying low iot. exercise tactical manoeuvres
- Flying condition okay (no flying under issues)
- Last point of contact: 2200
- Time 0300
- The flight is part of combined joint exercise:
  - 1 division land (NOR Bde, SWE Bde, FIN rangers Bn), 1 TG SOF, 1 sq F18, 1 sq JAS Gripen, 1 sq Black hawks)
  - Swe C-130, NATO Global Hawks, P-8 not part of exercise, but available

The map is made with Google Maps.

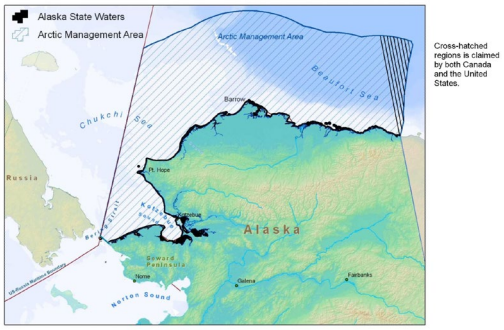
Scenario 5a:
Lost snowmobile party

- A group of 12 researchers on snowmobiles gets lost during a blizzard
- The expedition begins in **Kangerlussuaq**, a settlement in western Greenland known for its proximity to the ice sheet and its role as a hub for scientific research.
- The researchers aim to reach a remote field site near the **Russell Glacier**, approximately 25 kilometers east of Kangerlussuaq.
- We're in March, with bad weather and darkness (-15C, storm, snow)
- 48 hours since last heard from

The maps are made with Google Maps.

Scenario 5b:
Lost hunter party

- A group of 12 US hunters is lost during a blizzard
- We're in March, with bad weather and darkness (-15C, storm, snow)
- 48 hours since last heard from
- Area: Near an area of dispute between USA and Canada, The Beaufort Sea. The hunters started from U.S. territory but may have travelled along the coast near the disputed area and into Canada
- Military assets in the area:
  - U.S. and Canadian, standard forces
  - (Norwegian Coastal Rangers on CB90)



Both the picture and the map are from Wikipedia [9] [10].

D Courses of Action

D.1 Cruise ship rescue

Situation:

Scenario 1: A cruise ship with 2,000 passengers/crew is drifting in the icy waters north of Svalbard, due to engine failure.

Initial scoping:

Responsible nation: Norway. The location of the ship is known.

Possible COA:

- Rescue/save cruise ship, prevent loss of life and loss of vessel.
    - Initial principle: get assets to the ship, don't take people off the ship unless urgent.
- Prevent negative Public Relations (PR) and media attention.
- Minimize worst-case scenario.

Possible tasks within COA:

- Sustain the passengers on the ship through air drops, if the vessel is not in danger of drifting aground, colliding with ice bergs, capsizing, etc.
- Repair engine, by transporting parts and/or technicians to the ship.
- Deploy icebreakers, if the ship is frozen in solid ice.
- Deploy tugboats to the ship.
- Tow the ship to Longyearbyen, if the ice conditions allow it and tugboats are available.
- Evacuate smaller groups of passengers/crew if needed, including those with special/ medical needs.
- Plan for mass evacuation from the start, start implementing plan for worst-case scenario if the situation is critical.

Aspects of operational plan:

- **Information requirements:** Conditions of crew and passengers, incl. medical status. Status of cruise ship (incl. stability, heating, light, supplies, damages to engine). Sense of urgency, incl. whether evacuation needs to start immediately or whether crew and passengers can be sustained on the ship over some time. Mil-civ command and control. Available rescue resources/equipment, in area or deployable within relevant times. Available communication capabilities. Coordinated multinational communication to the public/PR. Coordinated response plan. Recognized Military Picture. Coordination between different involved governments.

- **C2 arrangement:** Norway lead nation. Follow pre-established agreements for MNF task force or arrange ad hoc force. Consider a forward operating base on Svalbard. Some relevant actors: JRCC Norway, civilian ships, coast guards, air forces, allied headquarters (HQ), rescue helicopters, Governor of Svalbard, cruise company, State Departments in involved nations.

- **Stratcom:** PR/messaging plan through a two-fold system: Coordination within the MNF, and PR/media plan.

- **Protection needs:** Charting data north of Svalbard. Danger of environmental pollution (oil spills). Interest/presence of non-coalition forces who wishes to "support" the operation.

- **Manoeuvre:** Arrange relevant flying assets. Airdrop parts or technicians to help repair the engine. Dispatch tugboats and/or ice breakers. Provide medical support and sustainment until tugboats arrive. P-8 surveillance aircraft available on Iceland, Evenes (NOR), and Lossiemouth (UK). Also: Need branch plan in case ship runs aground (catastrophic situation) prior to arrival of tugs. In worst case scenario if all passengers need to be rescued: Rescue passengers utilizing all available resources in accordance with agreements.

- **Logistics/sustainment:** Vessels of opportunity. Airdrops for sustainment. Medical facilities. Tugboats. Ice breakers. Medical evacuation (MEDEVAC). Worst case: major transport of personnel across Svalbard.

Possible challenges PMESII-PT:

- **Political:** Media attention. Involvement of Dept of State? What agreements are in place? What if nations want to rescue their own people? Borderless SAR: need for additional country support/coordination?

- **Military:** If available, will be tasked with towing, ice breaking, medical, engineering support. Use satellite pictures/drones to monitor vessel and ice conditions. There are likely few resources available in the area.

- **Economy:** Who is going to pay? Insurance? How to design sufficient SAR solution (resources/plans/agreements in place) to handle worst-case scenarios?

- **Society:** Media attention. Public perception.

- **Information**: Concern of misinformation coming from cruise ship. Need liaison on cruise ship? Chart accuracy north of Svalbard is a worry, due to changing ice conditions, whether seabed is mapped and surveys current, etc.

- **Infrastructure**: No infrastructure on north side of Svalbard. Limited infrastructure and medical services in Longyearbyen.

- **Physical environment:** Land and maritime search. Ice conditions. Weather. Polar code: Vessel is supposed to sustain for 5 days, is this realistic?

- **Time:** Response time tug, ice breakers, rescue resources. Urgency onboard the cruise ship. It will take a lot of time, both to bring more relevant resources into the area and to evacuate passengers. Example: Approx. 3 days for tug to reach site, approx. 2–3 days to tug vessel back to Svalbard/Longyearbyen. Example 2: Lengthy helicopter-based evacuation from Viking Sky outside the coast of Norway in 2019. Since cruise ships operate primarily in the summer, we expect that ice breakers will be able to get here (if available).

What ifs:

- **Fire:** Uncontrolled fire not unrealistic. Special firefighters might not be available, fire may have to be handled by ship crew. Water might not be the right tool for firefighting onboard, depending on conditions. Coast Guards may have firefighting teams (but very few). Evacuation on ice is challenging.

- **No heating:** Timelines shortens. Same planning, same resources and tools needs. May fly in batteries to power systems.

- **Mass casualties:** Urgent need to coordinate medical systems with other nations. Evacuation to all Nordic countries (Strategic Evacuation (STRATEVAC) capability might be a bottleneck). Respirators and other types of medical equipment might be issue. Can the MNF deploy Role 2 hospitals? Triage needs. Keeping track of evacuees would be challenging.

D.2 Missing helicopters

Situation:

Scenario 4: Two US helicopters based at Bardufoss, supporting Norwegian land forces as a part of a multinational force exercise, crash on the Swedish side of the border.

Initial scoping:

Responsible nation: Sweden. The location of the helicopters is not known. Last point of contact decides who leads the SAR – the group assumes the last communication was when crossing into Sweden.

Possible COA:

- Find the helicopters and establish need for rescue.
- Conduct rescue operation depending on needs and start evacuating wounded.
- Begin post-crash management and investigations.

Possible tasks within COA:

- Define responsible JRCC.
- Identify military and civilian resources that can provide SAR.
- Search for and locate crashed helicopters.
- Deploy rescue personnel.
- Provide help on crash site.
- Evacuate rescuees to health care or evacuation base.
- Post-crash management and investigations.

Aspects of operational plan:

- **Information requirements:** The Swedish JRCC will lead the operation and define the operational area. RCCs trying to get control of situation. The JRCCs are not aware what and if rescue resources are available, so the first step is to find out what resources are in the area and get tactical control in order to coordinate resources effectively. In this scenario the radar coverage on border could be a challenge. Other information needs are

how to find beacons or get satellite images over the area. If beacons are not working, search missions must be conducted.

- **C2 arrangement:** It is assumed that the helicopters are in Sweden and therefore the Swedish Maritime Administration is responsible (the Swedish JRCC). Cooperation is well defined in bilateral agreements and diplomatic issues are easily resolved between Norway and Sweden. The U.S. will also have diplomatic clearance according to exercise needs. The JRCC will need tactical control over resources provided by the MNF. If this is not possible a MNF can be given areas where they have control. During the mission C2 must be continuously updated.

- **Stratcom:** Stratcom issues will most likely be resolved by Swedish and Norwegian entities on strategic level. In today's security climate it would be useful to have a synchronized and agreed upon narrative.

- **Protection needs:** The need for winter training was stressed, both for helicopter crews and rescue personnel.

- **Manoeuvre:** Military aircraft. Land forces must be prepared to do mountain rescue and moved forward to probable sites. Other resources (like medical) also moved forward. Enable cross border mobility for forces. Medical system depends on facilities in the area. If there are evacuation needs, a fixed wing evacuation must be prepared. In Sweden, this is decided by the health care system.

- **Logistics/sustainment:** Forward basing could be very useful to search faster, and also to evacuate rescuees. This could be covered by MNF-deployable military bases, role 2 hospitals or similar. Helicopter forward refuelling points should be a part of this. In winter conditions this could be a challenging endeavour.

Possible challenges PMESII-PT:

- **Political:** If the location of the helicopters is not known, there might be a dispute over who leads the rescue mission. Diplomatic consequences if the rescue mission is poorly conducted.

- **Military:** Experiences from earlier situations indicate that the military could conduct own rescue mission outside the international agreements and national systems of responsibilities. The military also often have access to resources (aircraft, intelligence, personnel, ...) that could be used in a rescue setting. May be a challenge for the responsible JRCC to get access to these valuable resources.

- **Economy:** The typical principle in western countries is that rescuees will not pay for rescue missions.

- **Society:** In Sweden, the JRCC is not commanding/responsible for health services or health resources. Providing health services to the wounded is a coordination challenge. Media attention. Public perception.

- **Information**: Knowledge in the MNF about national rescue system and IAMSAR might be poor.

- **Infrastructure**: Basing in the north is sparse, especially hospitals.

- **Physical environment:** The area is cold and dark, with poor communication infrastructure. In this case, the radar coverage in the border areas would be a challenge.

- **Time:** Air crashes are always challenging timewise. People might be hurt and need medical attention fast. In addition, the cold is a challenge, unless the crew and passengers have winter training and equipment.

What ifs:

- **All aircraft are grounded:** The weather in the area is likely bad, which makes it harder to access the crash site. The JRCC might need special capabilities, i.e. special operating forces (SOF) or rangers with winter training and equipment. This means that SOF must be deployed into the rescue area somehow, without airlift. Searching will take days, which increases the need for the personnel who need rescue to have equipment and training. An MNF in the area might have access to intelligence systems (satellite coverage, electronic warfare systems and high-flying drones) that could be relevant in the search phase.

D.3 Missing hunter party

Situation:

Scenario 5B: A group of 12 U.S. hunters is lost during a blizzard, near an area of dispute between USA and Canada. The weather is bad, and it is 48 hours since last they were heard from. There are also military vessels from other countries than USA and Canada nearby that may support the operation.

Initial scoping:

Lead nation: USA or Canada, depending on local agreements and last known position. The location of the hunters is unknown.

Possible COA:

Locate and rescue the party and/or provide self-rescue resources, without escalation or perceived escalation/missteps.

Possible tasks within COA:

- Locate the party. They can be at sea, on the ice or on land.
- Provide self-rescue resources to support the party, when located.
- Rescue party, if necessary.
- Avoid escalation of situation, due to status of disputed area or cross-border operations.
- Minimize worst-case scenario.

Aspects of operational plan:

- **Information requirements:** Nationality of missing party. Status of missing party, incl. number of missing people, experience level, equipment, voyage plan and last known position. Communication capabilities. Mil-civ C2. Coordinated multinational communication to public/PR. Coordinated response plan. MEDEVAC needs and systems. Recognized Military Picture. Coordination between different governments. Cross border comms.
- **C2 arrangement:** Use current responsibilities between USA and Canada, but with possible MNF support. Must also include volunteer search parties, native/municipal SAR entities, etc.
- **Stratcom:** PR/messaging plan through a two-fold system: Coordination within the MNF. PR/media plan.
- **Protection needs:** Quality of charting data is a concern.
- **Manoeuvre:** COA 1, Stay in Place: Locate, ability to communicate with party, provide sustainment equip, get party to a shelter. COA 2, Evacuate Party: Locate, ability to communicate, if/when weather permits evacuate party. Generally: Fixed wing aircraft support, unique environmental requirements (snowmobiles).
- **Logistics/sustainment:** Fixed wing aircraft support. Airdrops of resources for sustainment. Volunteer ground search support. Medical facilities.

Possible challenges PMESII-PT:

- **Political:** Identify nationality of missing persons, location considerations. Media attention: Involvement of Dept of State? What agreements are in place? Borderless SAR: Would USA send a 3rd party country into Canada in support of the rescue operation, and how? Coordination needs between involved nations.

- **Military:** Available resources and basing. Potential for escalation.
- **Economy:** Not considered.
- **Society:** Media attention. Public perception.
- **Information**: Chart accuracy. Unstructured local communication. Is the AMVER system used? (Automated Mutual-Assistance Vessel Rescue, a worldwide voluntary reporting system run by the U.S. Coast Guard, for vessels that can support a SAR operation)
- **Infrastructure**: Available basing. Limited infrastructure.
- **Physical environment:** Land and maritime search. Ice and weather conditions. Experience/endurance of missing party. Use of drones: Permissions/different regulations between nations.
- **Time:** Response time. Uncertainty of exposure time for the missing party. Nature of distress call plays a role impacts urgency of response.

About FFI

The Norwegian Defence Research Establishment (FFI) was founded 11th of April 1946. It is organised as an administrative agency subordinate to the Ministry of Defence.

FFI's mission

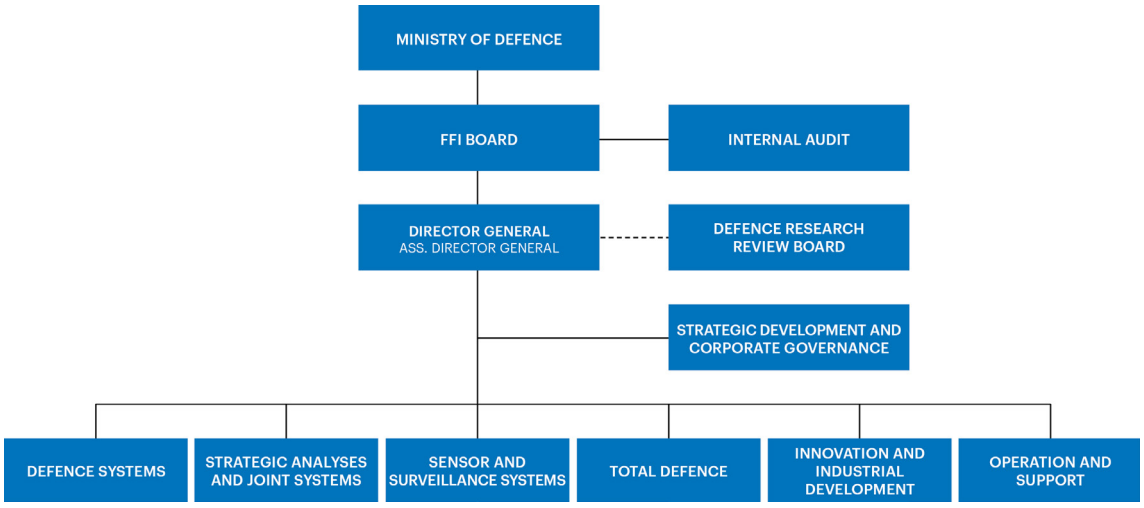
FFI is the prime institution responsible for defence related research in Norway. Its principal mission is to carry out research and development to meet the requirements of the Armed Forces. FFI has the role of chief adviser to the political and military leadership. In particular, the institute shall focus on aspects of the development in science and technology that can influence our security policy or defence planning.

FFI's vision

FFI turns knowledge and ideas into an efficient defence.

FFI's characteristics

Creative, daring, broad-minded and responsible.



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