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RESEARCH ARTICLE

Offshore is Onshore: Scalability, Synchronization, and Speed of Decision in Arctic SAR

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With its massive size, small population, and extreme climate, the Arctic is a highly relevant case for studying Search and Rescue (SAR) in remote and challenging environments. Climate change leads to increased shipping, tourism, and oil and gas exploration in the Arctic, creating new risks that need to be mitigated. The three major challenges to Arctic SAR are: (i) limited SAR capabilities, (ii) a multi-jurisdictional context with multiple Danish/Greenlandic and civilian/military authorities involved, and (iii) the need for coordination of a diverse set of organizational units operating both onshore and offshore. We use the case of a large-scale SAR exercise, LIVEX 2016, held off the west coast of Greenland, to explore these challenges from a three-tier analytical approach: *Scalability*, which investigates surge capacity in crisis management, *Synchronization*, which focuses on challenges related to the creation and maintenance of a situational picture during a SAR operation, and *Speed of decision*, which looks at how complex matters are managed in a multi-jurisdictional context under time pressure. Our findings show: (i) that surge capacity requires more focus on integration than activation, (ii), that actors must question information and challenge their own interpretations to maintain a synchronized situational awareness, and (iii) that urgency may result in a decrease of speed in decision-making.

Keywords: Arctic; coordination; distributed sensemaking; emergency management; search and rescue

1. Introduction

The Arctic has always been a challenging location for human activities due to the cold weather, extreme distances, and the polar ice (Lauta et al. 2018). Yet, nowadays climate changes melt the polar ice faster than ever and open up the Arctic for cruise ship tourism and other maritime activities. Shipping routes that until recently were inaccessible to non-icebreaking vessels are now open to maritime traffic during the summers, posing new challenges to Arctic emergency and crisis management systems with regard to both coordination and resources (Pincus 2015). A recent marine environmental risk assessment estimated a 24 percent overall increase in maritime traffic from 2013 to 2027, measured in sailed distance, with a 100 percent relative growth in cruise ship traffic, 20 percent in passenger traffic, and 2,543 percent in bulk carrier traffic, a total increase of 205,940 nautical miles (DNV GL 2015).

Arctic Search and Rescue (SAR) is very demanding due to long geographical distances between populated locations, a dispersed physical infrastructure, and potentially extreme weather conditions. The Danish Arctic Search and Rescue Region covers more than three million square kilometers, stretching from Canada in the west to the Norwegian and Icelandic regions in the east. Survivors of either a shipwreck or plane crash are very likely to be in grave danger because of the hostile environmental surroundings. Section 6.15.9 of IMO's IAMSAR (International Aeronautical and Maritime Search and Rescue) manual clearly addresses this issue:

> The consequences of poor preparations for [Mass Rescue Operations] in terms of loss of life and other adverse results may be disastrous. Major incidents may involve hundreds or thousands of persons in distress in remote and hostile environments. A large passenger ship collision, a downed aircraft, or a terrorist incident could, for example, call for the immediate rescue of large numbers of passengers and crew in poor environmental conditions, with many of the survivors having little ability to help themselves (IMO 2007).

Rescue assets will only have a limited window of time to reach survivors before they die from exposure. In case of an emergency landing by a transpolar flight on the ice cap in the middle of Greenland or the evacuation of crew and passengers from a sinking cruise ship to a remote island or to the ice, the task can be to keep more than a thousand people alive for up to five days until maritime or land-based rescue assets reach the area. Until then, keeping survivors alive is only feasible by airdropping survival kits and possibly also SAR technicians from long-range fixed-wing aircrafts, and parachuting rescue equipment and personnel into a disaster area may very well be hindered by the extreme weather often experienced in Greenland.

The risk of mass casualty incidents is very real as large cruise ships with thousands of passengers and crew regularly visit the area. In August 2016, the 68,870 ton *Crystal Serenity* sailed from Seward, Alaska, to New York City through the Northwest Passage with 1,700 passengers and crew, the largest passenger ship at that time to ever transit these remote and dangerous waters (Goldenberg 2016; Jepson 2016). The standing assets available for a response to, for example, a large cruise ship emergency are limited. An effective response therefore requires not only scaling of the capacity of the involved organizations, but also a sustained ability by these organizations to synchronize activities with their counterparts and fast decision-making about complex issues. Hence, we focus on the following research question: What are the challenges associated with scaling, synchronizing, and speedy decision-making during Arctic SAR operations?

In this paper we address our research question by (i) laying out a conceptual framework for analysis of scalability, synchronization, and speed of decision, (ii) presenting the Search and Rescue (SAR) organization in Greenland, (iii) analyzing a 2016 live exercise based on the abovementioned conceptual framework, and (iv) highlighting a number of insights and potentials for improvement.

2. Conceptual Framework

The title of this paper is inspired by an experienced Icelandic crisis manager who in 2015 expressed to one of the authors that any maritime emergency can be lost at sea – but only won on land: "Offshore is onshore", he said. Swift and effective coordination of assets, plans and procedures for scaling up operations and cooperation between sectors and agencies and with other nations make the difference between failure and success. We propose a conceptual framework consisting of three core components: Scalability, synchronization, and speedy decision making. Below we present each of the three components and anchor them in a broader understanding of emergency management approaches and theories.

2.1 Scalability

In remote and sparsely populated areas, such as the Arctic, the scalability of emergency management systems is important. Scalability concerns the capability of emergency management systems to quickly scale-up to accommodate large-scale incidents and is typically achieved through systematic preparing and planning. Medical Emergency Response facilities are usually organized with this in mind and may serve as inspiration for other sectors in emergency management (Zilm et al. 2008). The aim of scalability is to maintain a sufficient, but not excessive level of staff, equipment, etc., to deal with everyday incidents, while at the same time cultivating a system that can manage large-scale incidents. It is always a matter of a fine balance: if too much focus is allocated to the management of minor routine incidents in the most efficient way, outlier events can be impossible to cope with. Yet, maintaining a high level of preparedness around the clock for something that only happens rarely is too expensive. Surge capacity or "scalability" is one answer to this dilemma in emergency management – building organizations that can be transformed quickly to provide the necessary extra capacity in extreme situations without the cost of constant over-capacity (Sheikhbardsiri et al. 2017).

The major challenge associated with scalability concerns the effective integration of additional assets into an emergency management system in operation. This can be challenging because integration (a) must happen while the emergency evolves, and even experienced and trained assets need time to understand an emergency, which most likely is not like any of those experienced previously, and (b) requires cooperation between assets which differ with regard to mandate, experience, skills, and professional cultures.

2.2 Synchronization

Synchronization concerns the need for a Common Operational Picture (COP) and effective communication and coordination across sectors (Comfort 2007). Such synchronization among the organizational units making up an emergency management system is crucial for the success of the system (Bharosa et al. 2010; Comfort & Kapucu 2006; Faraj & Xiao 2006; Helsloot 2008; Janssen et al. 2010; Wolbers et al. 2018; Wolbers & Boersma 2019). Lack of synchronization often results in waste of precious time and resources or possibly in the undertaking of counterproductive activities (Roux-Dufort & Vidaillet 2003).

The success of a SAR operation depends on the ability of the participating organizational units to synchronize their ongoing local and distributed sensemaking and thereby to maintain a COP (Lu & Xue 2016; Weick 1993; Wolbers & Boersma 2013). Yet, maintaining a COP often proves challenging due to the distributed nature of the collaborating organizational units' activities, and because diversity in training and experience of their personnel creates a breeding ground for fragmented sensemaking (Maitlis 2005). Fragmented sensemaking denotes how members of organizational units make sense of emergency-induced events in diverging and contrasting ways (Merkus et al. 2017). When this happens, the collaborating organizational units generate more diverse sets of what can be labeled Local Operational Pictures (LOP).

Synchronization and the maintenance of a COP can also be hampered by information asymmetries among organizational units (Wolbers & Boersma 2013; 2019) which may evolve over the course of a SAR operation. Information asymmetries occur in different ways. An organizational unit may, for example, notice a development or an event, but may either delay sharing information about this with other organizational units or not share it at all. When this happens, variations evolve in the LOPs maintained by the organizational units. Research on disaster response management have found that actors involved in disaster response exercises perceive sharing of information as important for the success of their own organization and for the exercise as a whole (Bharosa et al. 2010). Yet, these actors were more concerned about getting information from others than about sharing the information they themselves possess. As a possible explanation of this conundrum, it has been suggested that the unpredictable and uncertain nature of emergencies makes information sharing complex as it is difficult to assess if a certain piece of information will be of value to others. Nevertheless, the consequences of limited information sharing can be severe as it may result in inappropriate allocation of resources, delayed evacuations, etc. (Dawes et al. 2004).

2.3 Speed of Decisions

The speed by which decisions about complex issues can be made is always an important factor when responding to emergencies (Schakel & Wolbers 2019). In a study of SAR operations following large-scale disasters in the United States, the American disaster researcher Thomas Drabek suggested that "disasters alter the decision environment." One particular change is the "simultaneous strains that push the organizations in contradictory directions." That is, disaster situations push organizations to decentralize within the organization in order to meet the increased need for speedy decision-making and, simultaneously, this push increases the need for coordination with other organizations (Drabek 1985: 90). Other parts of the literature frame the need to adapt organizational procedures as the need for agility, flexibility and creativity in decision-making (Harrald 2006; Mendonca et al. 2001). Studies of how organizations need predefined institutions and procedures on the one hand and are in need of flexibility and adaptability on the other hand, often suggest that, contrary to popular believe, they are not contradictions. Thus, a well-functioning crisis organization is defined by being able both to follow pre-defined organizational patterns and to know when to deviate from these in order to address potential gaps or uncertainty in the systems. One particular challenge often mentioned in the literature in this regard is that most information sharing and decision-making systems are created from, and exercised through, probable scenarios and thereby focus on routine emergency operations. Accordingly, this type of system favors routine and procedure rather than the ability to deviate from such procedures (Faraj & Xiao 2006; Janssen et al. 2010).

3. The Empirical Context

Covering 2,166,000 square kilometers, Greenland is the world's largest island and one of the most sparsely populated countries with only 56,000 inhabitants. Approximately one-third of the population lives in the capital Nuuk on the south-western coast, while the rest lives in smaller towns and settlements, predominantly on the west coast of the island.

Greenland is an autonomous country within the Kingdom of Denmark. Since 2008, when a majority of the Greenlanders voted in favor of the Self-Government Act, more responsibilities have been transferred from the Danish State to the Greenlandic Government. However, with regard to emergency management, a mix of Danish and Greenlandic authorities continue to be involved. The Greenlandic Police is Danish and operates similarly to other police districts in Denmark, while fire and rescue services are under local municipal jurisdiction. Health services are provided by the Greenlandic Government, while the foreign policy and defense are controlled by the Danish State – with implications for the emergency management as the Royal Danish Navy plays a major role in SAR operations in Greenland. The Greenlandic Government does not maintain either a civil protection organization or an emergency management agency to support local fire and rescue brigades.

The Greenlandic crisis management system is organized along the same principles as the Danish national crisis management system which distinguishes between the political/strategic, operational and tactical level. The political/strategic level defines the goals of an operation, while the operational level plans, coordinates, and manages accordingly, and the tactical level executes in order to obtain the goals as defined (DEMA 2015). Also, the Greenlandic crisis management system subscribes to the principle of sector responsibility, meaning that those who perform the day-to-day management also manage and maintain responsibility during an emergency.

In Greenland, the political/strategic level is the Emergency Services Commission (ESC), chaired by a representative from the Greenlandic Government, usually the permanent secretary of the Ministry of Science and Environment. Other members of the ESC include: a representative from the Association of Greenlandic Municipalities, acting as permanent vice-head of the ESC; the commander of the Joint Arctic Command (JACO); the chief constable of the Greenlandic Police; the Chief Medical Officer (an independent audit and counseling authority for the health system in Greenland); the Danish High Commissioner of Greenland; and representatives from the Greenlandic Government's Ministry of Nature and Environment and the Ministry of Health.

Two core responsibilities of the ESC are the production of a continuously updated situational picture to the decision-makers at the political/strategic level and the coordination of the strategic and economic resources available during emergency operations. The ESC is supported by an ad-hoc secretariat located in the Department of Environmental and Contingency Management.

On the level just below the ESC, we find the Greenland Operational Staff (GOS), a coordinating body headed by the Greenlandic Police and responsible for managing incidents at the operational level. The members of the GOS largely mirror those of the ESC, but represent a lower organizational level. JACO is, for example, represented by its commander in the ESC and by a lower-ranked liaison officer in the GOS. In case of major incidents, the police activate a small Strategic Group (SG), consisting of the chief constable of police and his top-level managers. The SG aims to connect the GOS and the ESC.

Below the GOS, we find the different sectors' tactical levels: the Command Station at the police HQ, the on-scene incident command post of the police, the fire and rescue service incident command, the management at the hospital, etc., where the practical cooperation takes place. An important coordinating element of the Greenland crisis management system is the use of liaison officers at the operational level.

3.1 Search and Rescue in Greenland

Contrary to many other Arctic coastal states, Denmark does not operate a dedicated coast guard service (Dahlberg 2019). Hence, in the Danish zone of the Arctic, civilian tasks, such as SAR and maritime pollution prevention and response, are the responsibility of the Royal Danish Navy and the Danish Defense as a whole. In recent years, most of Greenland's on average 95 SAR operations per year happened at sea inside the three nautical miles demarcation line that separates the areas for which the Danish Defense and the Greenlandic Police are responsible, respectively. However, these operations were of a limited scale, and thus they were managed by the police. Civilians and/or the local police cutters handled most of them.

Offshore SAR in Greenland is, however, the responsibility of the Danish Defense and has in recent years been high on the agenda along with the changing security situation in the area. In 2016, the Danish governmental administration published several analyses of the Arctic situation, all showing the need for a stronger presence in the Arctic by the Danish Defence and for more resources to support the Greenlandic authorities with rescue capabilities (Taksøe-Jensen 2016). In particular, the Danish Ministry of Defense recommended reinforcement in three domains: "Surveillance", "Command, Control, and Communication," and "Operational Units" (Forsvarsministeriet 2016: 11).

In order to address these needs, a number of initiatives have since been taken. For example, the Arctic Response Force (ARF) has been established. The ARF is a range of assets that can be mobilized quickly by the Danish Ministry of Defense in case of a major emergency. The assets include military units, experts from the Danish Emergency Management Agency (DEMA), volunteers from the Home Guard, and logistic support units. All assets can arrive in Greenland between 12 and 36 hours after a call for assistance (Forsvarsministeriet 2016: 48, 93-94). ARF provides the surge capacity needed for JACO to manage large-scale operations lasting several days while at the same time supporting local authorities with equipment and specialists.

Since October 1, 2014, air and maritime rescue (major incidents) in the Danish Arctic Search and Rescue Region has been coordinated by the Joint Rescue Coordination Center (JRCC) in Nuuk, located at the headquarters of JACO. JACO operates a number of assets in the area: four large inspection ships of the Thetis class with organic helicopters and three smaller inspection vessels of the Knud Rasmussen class with helicopter landing and refueling capability. Typically, one inspection ship and one inspection vessel are on duty in the Greenlandic waters at any given time, conducting routine patrols, bathymetry, and fishery inspections. JACO also operates a CL-604 Challenger surveillance aircraft out of Kangerlussuaq (the main airport in Greenland), 190 miles from Nuuk, while the civilian Greenlandic airline Air Greenland, acting as a subcontractor to the Danish Defense, supplies one S-61N SAR helicopter stationed in Kangerlussuaq or Nuuk and a BELL 212 helicopter in South Greenland. None of the helicopters have all-weather or night capabilities, nor are they equipped to refuel from Danish navy vessels. The S-61N helicopter is equipped with a rescue hoist, but does not carry a rescue diver.

Onshore and coastal SAR falls under the responsibility of the Greenlandic Police. Small-scale SAR operations in coastal waters are usually managed with police cutters of the Sisak class stationed in Nuuk and other towns on the west coast. The Greenlandic Police operates four of these small cutters, each manned with a crew of 5-6 experienced mariners who are civilians trained and employed by the police. An agreement ensures that the police can always request that JACO's resources assist with SARs, just as JACO can request assistance from the Greenlandic Police. In such cases, the operation would still be formally coordinated by the police, while on-scene coordination is performed by the either the most capable military or civilian vessel in the operations area or a police cutter.

3.2 Greenland LIVEX 2016

In recent years, several emergency management exercises have been held in the Greenlandic waters. Greenland LIVEX 2016 combined many elements from previous scenarios in one large-scale live exercise based on the following scenario: a collision between a cruise ship, *Gute*, and a small product tanker, *Færingehavn*, just west of Nuuk. The exercise was formally "owned" by the Greenlandic Government, but the Danish Defense was responsible for its planning, execution, and evaluation. Following the NATO manual for exercise/design, a number of planning conferences were held in 2015 and 2016, where all stakeholders involved developed the scenario and the timeline.[1]

STARTEX was at 10 a.m. local time on Saturday, May 28, 2016. The weather conditions were exceptionally good, so low visibility had to be simulated in the exercise to ensure that the electronic surveillance equipment on the available assets could be deployed and tested. A simulated distress call on civilian VHF radio from *Færingehavn*, stating that the vessel was sinking after a collision with *Gute*, initiated the exercise.[2] The Danish inspection cutter *Tulugaq*, the closest surface vessel to the incident, relayed the distress call to JACO, whose duty officer initiated the coordinated response and activated the Command Station at the police station in Nuuk. Thereafter, the police officer on duty notified the Danish National Police in Copenhagen about the accident and the start-up of the Command Station.

[1] The authors attended the preparatory conferences and made visits to Nuuk prior to the exercise in order to negotiate access and do informal interviews with key stakeholders. During the exercise, the authors undertook a field study which included on-site observations, collection of documents and informal interviews at four different locations: on scene, at the police station's Command Station, at ESC and Naalakkersuisut, and finally at JRCC and JACO. With permission from the exercise owners, notes were taken in shorthand during the observations and later transcribed and translated into English. Audio from some sequences was also recorded for analytical purposes, and the authors documented important moments, interactions and modes of coordination with photographs.

[2] The small cargo ship *Færingehavn* did not physically participate in the exercise, while *Gute* was enacted by a large Swedish RO/RO ship of the same name, complete with 200 role players and containers, specially designed for training purposes. Rafts and crew members from *Færingehavn* were either simulated on paper or simulated by dummies in the water.

Meanwhile, JACO coordinated its assets: *Tulugaq* was to proceed at best speed towards the incident area while the large inspection ship *Thetis* was expected at 7 p.m. The two inspection vessels, *Knud Rasmussen* and *Ejnar Mikkelsen*, were six to eight hours away.[3] As there was only one SAR helicopter in the Nuuk area, *Thetis* sent its Lynx helicopter to refuel at Nuuk airport, so it could operate in the incident area just after noon. Also, the four police cutters stationed in Nuuk were activated. The first police cutter, *Sisak*, departed from Nuuk at 12.10 p.m. with two police officers and the Fire and Rescue Incident Commander from the municipal fire and rescue service aboard. As the first responding vessel, *Sisak* assumed the role of On Scene Coordinator.

The ESC held its first meeting at 1 p.m. The commanding general from JACO briefed the civilian sectors on the situation and announced that he had activated the ARF. Around 4 p.m., the first assets from ARF arrived in Greenland,[4] including military personnel, volunteers from the Home Guard, a special forces team from the Danish Frogman Corps, and rescue specialists from DEMA.

The exercise ended on Tuesday, May 31, at 5.50 p.m. The final counts showed that 18 persons had died, and approximately 60 had been injured in the collision that involved 218 passengers and crew members in total and kept more than 300 emergency managers busy during the four-day response phase. It is our assessment that the outcome underlines the reasons why it is necessary to undertake such simulated activities, even though the value of emergency management exercises is disputed by some authors (van Harperen 2001). Do they provide us with useful information about the shortcomings of organizations, equipment, and doctrines? Or do they, in the best case, merely improve our ability to carry out exercises with preferred outcomes? We acknowledge that an exercise is by no means equal to an actual response as it is difficult to simulate the "fog of war," but we argue that an exercise offers valuable access to processes that are also evolving during actual responses.

4. Analysis

We classify the response to the scenario in LIVEX 2016 as a Mass Rescue Operation, in accordance with the definition in the IAMSAR manual: "...one that involves a need for immediate assistance to large numbers of persons in distress such that capabilities normally available to SAR authorities are inadequate" (section 6.15.1). In a Mass Rescue Operation, all levels of the involved organizations must perform and adapt. LIVEX 2016 can be viewed as a showcase for how important a well-structured and attuned *onshore* organization is for the effectiveness and success of an offshore operation. The need for a well-organized backend structure to support and lead rescue units at the "sharp end of the system" has been recognized by the international SAR community since the 1950s, leading to the development of the UN agency for maritime affairs (IMCO/IMO) and, in 1998, the publication of the IAMSAR manual. Looking specifically at the Danish context, the loss of the ship *Hans Hedtoft* in January 1959 prompted authorities to create a modern SAR infrastructure in Greenland (Dahlberg 2019).

We now return to the three dimensions of this adaptive process: scalability, synchronization, and speed of decision, and we analyze the challenges associated with accomplishing these dimensions during Greenlandic LIVEX 2016, an Arctic SAR operation.

4.1 Scalability: Fresh Out of Denmark

Based on our observations during LIVEX 2016, we investigated scalability at two managerial levels with focus on JACO: (i) deploying the internal surge capacity at JACO, and (ii) activation and integration of the Arctic Response Force.

The first level deals with the shift from everyday activities to managing a large-scale incident. As in the exercise scenario, real offshore SAR operation in Greenland is typically triggered by a call for assistance to JACO, either via civilian radio or by telephone. The duty officer (the JRCC at JACO is manned 24/7) receives the call and decides on the appropriate response: involvement of the Greenlandic Police, deployment of various SAR assets, etc. If needed, the duty officer has a backup senior officer on call to confer with. When an incident out of the ordinary occurs, the small daily operational staff at JACO can be scaled up. Off-duty staff is quickly summoned allowing the Joint Operations Center (JOC) at JACO to handle more complex and/or simultaneous incidents. As the majority of the staff lives in Nuuk, it is usually feasible to scale up the

[3] All ships were actually positioned in Nuuk harbor, but delayed in the exercise to simulate that in a real situation they would probably be somewhere else in the huge Search and Rescue Region.

[4] Mobilization and deployment of the Arctic Response Force was simulated during the exercise: the resources were already in Greenland at STARTEX. In a real situation, it is unlikely that any assistance from Denmark would arrive sooner than 12 hours after a call.

operational capability of JACO considerably within one or two hours, although weather conditions, weekday, hunting season, etc. may affect mobilization speed. The small organization of JACO with its limited manpower has an upside and a downside. Everybody at JACO knows each other and can easily take responsibility for various tasks, but JACO cannot run a large-scale SAR operation for more than approximately 24 hours due to expected manpower fatigue. Hence, the ARF was established.

The ARF can be activated from Greenland, either directly by the commander of JACO (the operational level) or indirectly by a call for assistance from the ESC (strategic level). As the ARF is an inventory of the currently available assets, the size and exact composition of a rapidly deployable support team to JACO is unknown, but it typically consists of enlisted personnel and staff officers with some experience from the Arctic theatre, as the recurrent Arctic exercises have established a pool of people with Arctic experience and knowledge of JACO. During LIVEX 2016, approximately 30 men and women joined JACO as additional staff from Denmark, adding to the 43 ordinary JACO staff members on duty.

The additional staff arrived at JACO at 5 p.m. on day one, simulating a six-hour delay from the activation of the ARF. Daily briefings helped integrate the additional staff and develop a common understanding of the situation. An arrival with a six-hour delay from the activation was very optimistic, as the normal flight time from Denmark to Greenland is at least four hours. Hence, an important insight from the exercise is that surge capacity does not come easily. On the one hand, it requires that plans are in place; on the other hand, it requires (or demands) that points of contact have been established in advance as it is otherwise difficult for an organization to integrate additional staff into its existing structure. The result may be inefficiency and, in the worst case, even counterproductive if the ordinary staff must allocate its limited and strained resources to introducing additional staff to tasks and practices and spend time to assess the new arrivals' skills and capabilities.

Looking at the upper managerial level, we identified the challenge of integrating the local activities into a larger regional and international framework. Rescue resources, and especially health facilities, may quickly become overwhelmed in sparsely populated areas such as Greenland, and it is therefore highly relevant to plan for scalability. Such surge capacity is dual in purpose: personnel and equipment must be able to flow *into* the affected area while casualties simultaneously can be *evacuated* from the area in a safe and efficient manner. This is not only a question of airplanes and runways: the entire system must be ready to send, transfer, and receive people and goods within hours. It requires pre-planning within a Host Nation Support framework, compatibility of communication systems, and joint training. Finally, scaling at the third level indirectly showed how important this would be in a real situation: the Greenlandic health authorities did not participate fully in the exercise because of limited resources. Therefore, transfer of patients and evacuees, etc., abroad was not rehearsed. Medical emergency facilities in Nuuk were, however, supported by a field hospital airlifted from Denmark as part of the ARF which took over when the local authorities pulled out of the exercise on day 2. This demonstrates that assistance from the outside will be crucial to support the Greenlandic health system in case of a Mass Rescue Operation in the area.

Scalability – on all managerial levels – is key to success in modern emergency management. However, during LIVEX 2016, a number of challenges: the initial up-scaling at JACO from daily routines to organizing for extremity depends on (1) the duty officer's ability to sense the immediate urgency of the situation, and (2) the organization's level of preparedness. While the former is to some extent a derivative of personal experience and skills, the latter can be defined and rehearsed. An important lesson learned during the exercise was that the shift from normal to extraordinary modes of operation could be improved at the organizational level to ensure fast response in the important early hours. In particular, staff members reporting for duty were not always given clear roles and areas of responsibility which resulted in a less than perfect division of labor. Activation of the ARF was swift, while the integration into the existing organization of additional staff members as they arrived at in Nuuk could be improved by presenting the available capabilities to JACO in a more structured way.

4.2 Synchronization: What's the Situation Out There?

Over the course of a SAR operation, there will often be deviating perceptions of how the emergency evolves which may give rise to decisions about deployments of resources that other participating organizations do not understand. In particular, two incidents during LIVEX 2016 illustrated this challenge.

Approximately seven hours into the exercise, the Fire and Rescue Incident Commander, after boarding *Gute*, requested an immediate evacuation of all passengers from the ship, as he had observed highly toxic and potentially deadly chemicals on the vessel. The request made no sense to the police officers located in the Command Station at the police station as they had not been informed about the chemicals, but nobody

thought about asking the Fire and Rescue Incident Commander why he requested the immediate evacuation. Instead, their reaction was: "What's he doing out there, he holds no authority to order an evacuation." Hence, two deviating perceptions of the situation evolved, and there was no longer any COP for the two organizational units involved.

A second challenge concerns the fact that events and developments are sometimes "enacted". Contrary to real events and developments, like the observation of toxic chemicals made by the Fire and Rescue Incident Commander, enacted events and developments come about as actors "play a crucial role in fabricating the very situation they are trying to comprehend" (Wolbers & Boersma 2019: 20) in an attempt to make sense of ambiguous information and observations (Weick1995; 2015). In another incident, roughly three hours into the exercise, the police officers aboard the police cutter *Sisak* overheard a police radio conversation from which they concluded that a total of three ships were involved (they probably misunderstood one of the names due to radio clutter). Thus, they asked for permission not to stop as they reached the position of *Gute* which they believed "just" experienced rudder problems. Instead, they wanted to continue to the position of the collision in order to search for victims from *Færingehavn* and a third ship called *Bering*. Approximately 15 minutes after asking for permission to proceed to the position of the collision, the police officers aboard *Sisak* requested confirmation from the police Command Station that *Bering* and *Færingehavn* were the two ships involved in the collision – something that could have immediately clarified this misunderstanding. However, the onshore staff had now directed their attention elsewhere. For example, there were rumors about the captain on *Gute* being intoxicated (drunk); they had to decide what to tell the press about the incident; they wondered how the weather would develop in the area of the search and rescue operation; and there were concerns about the possibility of oil spills from the involved ships. Thus, apart from noting that the name of the ship was *Færingehavn* and not *Bering*, the onshore police staff paid little attention to this request from *Sisak* which was steaming on towards the position of the collision. Upon arriving, *Sisak* searched for survivors for about two hours before concluding that the existence of the third ship *Bering* was probably a misinterpretation. By then, precious time and valuable rescue capacity had been wasted due to the enactment of what turned out to be an imaginary ship.

At first glance, the absence of inquiries seemed odd. The Fire and Rescue Incident Commander's request for an immediate evacuation of the passengers from *Gute* made little sense in the Command Station. However, during the first three to four hours of the exercise, the onshore staff experienced an overload of issues and information, and they continuously attempted to figure out what had happened and what was happening right now. Furthermore, the personnel at the Command Station had strong faith in the existence of a COP among the involved organizational units, and they never checked if this was actually the case. Hence, during the first eight hours of the exercise, they built a solid local interpretive frame which was not changed easily.

In our discussion above, two major issues regarding synchronization emerge. First, information asymmetries among participating organization units may cause the evolution of variations among LOPs. Consequently, participating organizational units may ignore crucial tasks and instead pursue tasks of little or no relevance to the success of the ongoing operation. Based on this, we suggest that organizational units participating in SAR operations must scrutinize incoming information more carefully and submit inquiries to information providers when they cannot make sense of the information, as also recommended by Comfort (2007). However, we do acknowledge that it might be difficult to do so during the first critical and chaotic hours of an emergency response. The second issue is more problematic as it concerns the participating organizational units' processing of incoming information. The fact that information is available does not ensure that somebody notices it as his or her attention might be directed elsewhere. And when information is indeed noticed, it might either not be given much attention or be abandoned as irrelevant under the present circumstances.

4.3 Speed of Decision: Those Chemicals Are Not Coming to Nuuk!

During emergencies, decision makers face a number of challenges as they must make decisions on issues outside the scope of their normal procedures, often with partners they are not accustomed to work with, and within an upscaled organization context. All these factors challenge the speed by which decisions can be made and communicated clearly in an emergency management system.

According to the exercise script, on the first day of the incident, two dangerous chemical agents were identified on *Gute* by the emergency managers. If those two chemicals mixed, the result would have been a highly toxic and flammable organic compound called Prussic Acid (hydrogen cyanide). The division of responsibilities in relation to the chemical agents was interesting. The decision of how to approach the situation was initially shared between separate institutional mandates. Therefore, the decision caused trouble

at both the political/strategic and the operational levels of the Greenlandic crisis management system, and slowed down the further decision-making. However, the speed of the decision-making accelerated when the chemicals did eventually mix, and this completely changed the dynamics in the crisis management system.

On day three of the exercise, after having ensured the safety of the persons onboard *Gute*, the Greenlandic crisis management system redirected its attention to focus on management of the dangerous chemicals on *Gute*. The challenge facing the system was to make a cross-institutional decision on how to approach the chemicals. Decision-making was particular difficult because none of the involved organizations had a clear mandate to deal with the problem offshore. The Greenlandic Police was in charge of the overall coordination of the emergency response, whereas the Danish Defense was responsible for operations at sea. Furthermore, the actual expertise to deal with the hazardous materials was shared among the local fire department, the Greenlandic Government's Ministry of Nature and Environment, and HazMat-experts who had arrived from DEMA as part of the ARF.

As theorized by Drabek (1985), this institutional set-up created a double pressure on the actors in the GOS. On the one hand, the different actors had to ensure that their internal organizational interests were considered. On the other hand, the immediate problem could only be solved by cooperating and combining the different actors' resources, experience, and mandates. Essentially, the system could address this complex problem with two types of interventions: Either it could try to salvage the chemicals safely from the ship, or it could tow the ship away from Nuuk – or do both. Luckily, by then all persons had already been evacuated from the *Gute* apart from a skeleton crew. Caught in the complexity, the actors in the GOS decided to create a memo outlining the possible decisions, including the risks these entailed, and submit it to the ESC. Consequently, organizational ambivalence about the decision prevailed for more than five hours until the memo was forwarded to the political/strategic level of the crisis management system. The chemicals "coincidentally" mixed five minutes before the meeting of the ESC commenced, thus drastically changing the outlook and dynamics of the decision. At that time, the commander of JACO and the chief constable of the Greenlandic Police discussed the strategic issue of distribution of responsibility and decided which strain of action to apply in less than three minutes.

To apply Drabek's (1985) term, decision environments are indeed altered during emergencies. We believe that three insights can be derived from the LIVEX 2016 example described above, and that these insights can serve as reflection points for decision makers involved in emergency responses: (i) decisions must be addressed by the appropriate level of the emergency management system. In LIVEX 2016, valuable time was lost because the operational level (GOS) attempted to solve what was fundamentally a strategic question of distribution of responsibility; (ii) time is not necessarily on your side. Indeed, decision makers often need to react fast in order to maintain a strategic upside. Reflection on this issue is crucial to ensure a constant dialogue on how to prioritize the resources available in an optimal manner; (iii) the optimal balance between predefined and rehearsed procedures on the one hand, and agility on the other, cannot be precisely defined. Rather, the mindful emergency management organization must maintain an awareness of the need for both and apply adaptive planning to address complex problem solving involving a variety of interests.

5. Conclusion

The main conclusion in the joint evaluation report, presented by the Danish Defense after the exercise, was that the combined Danish and Greenlandic emergency management system performed well during LIVEX 2016. Nevertheless, we find it important to highlight a number of insights and potentials for improvement in order to summarize our answers to the research question we presented in the introduction of this paper: What are the challenges associated with scaling, synchronizing, and speedy decision-making during Arctic SAR operations?

First, effective upscaling of operations did not happen at the operational and the tactical levels. The surge capacity was available to JACO, but the benefit of the added manpower was limited as the preparedness plan was not fully implemented, resulting in temporary organizational confusion and inefficiency. For example, despite the fact that the ARF was activated and deployed quickly, its integration into the existing JACO structure was slow. A generic lesson to be learned for emergency managers is – in the words of an experienced police auditor who participated in LIVEX 2016 – that "it doesn't do you much good to receive a lot of extra hands if you're not able to put them to useful work."

A related problem concerns the use of local personnel, such as police officers, in large-scale Arctic SAR operations. In Greenland, many police officers are located at remote and isolated locations with few or no colleagues nearby. They have not necessarily received the training needed to participate in the complex

systems and organizations involved in large-scale Arctic SAR, and on-the-job training is not always an option. These factors limit their usefulness in large-scale Arctic SAR operations. Nevertheless, in the remote Arctic, they are often the only resource available at relatively short notice. We recommend increased participation in SAR training in spite of the associated additional costs. Hence, in the Arctic, the problems related to scaling and integration of additional resources are different than those pointed out by Comfort (2007) who describes refusal to receive assistance and subsequent incapacity to harness contributions by volunteers as the main obstacles.

Second, with regard to synchronization, the fact that information is available is not sufficient to ensure a common perception of what is going on across the participating organizational units. Within the participating organizational units, there was little or no focus on the possibility that other units might maintain and act on a deviating perception of the unfolding of the emergency. Due to the long distances in the Arctic, deviating perceptions constitute a special problem, for example, when acting upon what happens to be a skewed perception of the unfolding of an emergency. Such actions result in a significant decrease in SAR efficiency. The police cutter *Sisak*'s search for the non-existing ship *Bering* serves as an excellent illustration of this problem.

We suggest that any emergency management organization contributing to large-scale complex responses in the Arctic must actively improve its ability to notice and scrutinize information that challenges its current perception of the unfolding of the emergency. In particular, we find that these organizations must address the following two questions: (i) how may an inquiring attitude be encouraged among the participating organizational units during SAR operations, and (ii) how may participating organizational units become better at noticing and considering incoming information which challenges their current perception of the situation? Pursuing a more inquiring attitude towards incoming information during SAR operations may be viewed as time consuming. Yet, it should be remembered that acting on a "wrong" perception is likely to cost much more time and resources than the time the organizational units will need in order to obtain the "right" perception.

Third, due to the distributed nature of Arctic SAR operations, the conditions under which a COP is to be maintained are problematic – both from a technological and an organizational point of view. At the time of LIVEX 2016, no comprehensive Situational Picture of the position of sea and air units in the Danish Search and Rescue Region around Greenland was available. Some systems for self-reporting of positions were active, but JACO could not provide the JRCC and the Greenlandic Police with a continuously updated Situational Picture, and this hampered the maintenance of a COP for the organizational units participating in the exercise. Hence, it is important to identify and implement technological platforms for the effective production and distribution of comprehensive situational awareness. Such technological platforms will form the basis for the development and maintenance of much needed shared COPs during Arctic SAR operations. However, it should be emphasized that such technological solutions will only be effective if the organizational units participating in these operations cultivate their abilities to maintain an inquiring attitude towards incoming information that challenges their current perception of the unfolding of emergencies.

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Competing Interests

The authors have no competing interests to declare.

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