Managerial Roles and Structuring Mechanisms within Arctic Maritime Emergency Response[1]

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Emergency response operations include a range of agencies who collaborate closely together. This is especially true in the Arctic regions where resources may be scarce. The participants within emergency response include a range of institutions such as: mission coordination centers, fire and rescue services, police, coast guard and military forces, private organizations, companies, and volunteers. In this paper, we illustrate the managerial roles of the incident commanders who coordinate and control emergency response, and the organizational mechanisms supporting the incident commanders. The purpose of this paper is to explore how the operational conditions found in the Arctic add to the inter-organizational coordination challenges. We build upon several illustrative cases to demonstrate how the managerial roles are influenced by their context. The key operational challenges in the Arctic region include harsh weather conditions, long distances to resource bases, and limited infrastructure. We argue that role flexibility, re-planning capability and authority delegation are critical prerequisites for an efficient crisis response in the Arctic. The capability for role switching is important for all key personnel involved in the maritime incident response. Results from in-depth case studies of maritime emergency operations in Norway are presented in this paper.

Introduction

Dealing with maritime operations and emergencies in the Arctic is challenging due to factors such as unpredictable weather that may hamper operations and reduce equipment functionality, long distances between the distress site and the resource bases, limited infrastructure that may increase mobilization time and create fatigue, and small communities with limited resources available for large scale operations (Marchenko et al., 2016, 2018). As a consequence, the International Maritime Organization (IMO) has introduced the Polar Code stating that the vessels in the polar regions need to introduce safety equipment that will guarantee five-day survival time. Accidents like fire on board a vessel, collisions and grounding of larger vessels in polar waters are among the most difficult tasks for the emergency response systems (Borch, et al. 2016a, 2016b).

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Large-scale maritime emergency response often includes a broad range of agencies with their own specializations, role structures, functions, plans and standard operating procedures. The participants in emergency response such as search and rescue (SAR) operations may include rescue coordination centers, fire and rescue services, police, coast guard and military forces, paramedics, private rescue organizations, as well as volunteers. Transparent management and coordination between several agencies is a challenging task. In a multi-faceted environment, we may also find a broad range of interlinked stakeholders like commercial interests, local communities, indigenous groups and environmentalists (Borch & Batalden, 2014).

Large-scale emergency response, like mass rescue operations from a cruise ship, are often multi-sectoral involving civilian and military resources as well as several ministries and agencies. These types of incidents are also low-probability, high-consequence events that seldom happen. These "black swans" may overwhelm the preparedness and response system of any country, calling for assistance from the neighboring countries. This is especially the case, if the incident requires special services like firefighting and treatment of complicated wounds, anti-terror, deactivation of explosives, chemical or nuclear operations, or underwater search.

Although the basis for emergency response services in all Arctic countries is the same, the way of organizing the emergency response system can be different. The existing institutional framework, including economic systems, industry standards, as well as political and legislative framework influence on how crisis management is delivered. With more institutions involved in the network and a heterogeneous operational context, the incident commander faces significant integration challenges (Schmied & Borch, 2016).

In this paper, our starting-point focuses on the multi-agency task forces with a complex web of various institutions, bringing their own procedures, command and control systems, competence, and norms and values. The purpose of this paper is to explore how the managerial roles and tasks at different command levels need to adapt to the complexity in the Arctic context. The study builds a theoretical framework from managerial roles and mechanisms for re-structuring and improvisation. We present four ship fire cases with maritime incident response groups assisting the firefighting efforts onboard ships. In the analysis chapter, we take a closer look into the roles of the incident commanders, the management aboard the unit in distress, and the leaders of the supporting units, and analyze how the structuring mechanisms may allow for a flexible and efficient use of heterogeneous resources.

Theory

Within emergency management, coordination between different actors and their incident coordinators may rely on factors such as agency interdependencies, and the established management structures and mechanisms for coordination and control. Coordination is an emergent process, in which different interdependent action trajectories are synchronized (Wolbers et al., 2017). Incident command systems facilitate leadership, coordination and information flow between multiple individuals and organizations (Rimstad et al., 2014). During the response process, incident commanders will coordinate and control the situation through specified routines according to their roles and procedures within the established incident command systems. In case of an unforeseen disaster, the response teams and emergency managers have to act as fast as possible to prevent additional damage. However, Isabelle et al. (2012) argue that coordination is

less dependent on design than on the tasks that emerge in response to coordination challenges. Therefore, there is a need for flexible emergency management capabilities balancing the tasks of the different actors (Roud et al., 2016).

Bigley & Roberts (2001) highlight that the range of managerial tasks has to be matched by adequate coordination and control mechanisms in order to achieve an effective agency interplay. Command structures are the coordination tool for efficient direction of responsibility and authority. In addition, robust coordination between institutions with varied organizational systems and professional platforms calls for more tailor-made managerial role models and inter-organizational structuring tools to face these challenges (Borch & Andreassen, 2015).

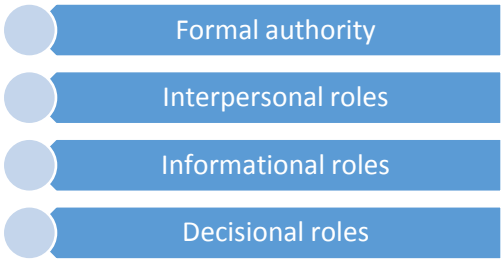
Command Systems

Within emergency management, command and control systems are vital for fast, and coordinated response. When it comes to the structuring of the emergency response organizations, the standardized incident management systems are designed to be consistent with the general principles of organizational management. The coordination and decision-making is executed through well specified roles and functions. As an example, the standardized Incident Control System (ICS) was created in the 1970s to facilitate up-scaling of the emergency response without losing control. The ICS structure was based on experiences from the fire departments fighting wildfires in Southern California. The original ICS approach has been developed and revised since then in order to become suitable for teams across different jurisdictions. The basic ICS includes a standard management hierarchy.

Managerial Roles

Managerial roles are defined by Mintzberg (1973, 2009) as sets of actions types and responsibilities that are assigned for each of the managers in an organization. Mintzberg claims that managerial roles within an organization can be conceptually separated into three main groups: interpersonal, decisional and informational (Figure 1).

Figure 1. Types of managerial roles (Mintzberg (1973).



The starting point for these roles is the formal authority that defines the position of the persons involved. Interpersonal roles include the figurehead whose role is both internally motivate and inspire, but also represent the organization externally to different stakeholders, for example media and interest groups, the leader who performs leadership duties towards subordinates, like hiring and training the staff, and the liaison role, which establishes contacts outside the organization. Informational roles include a monitor who scans the environment and receives all kind of information, a disseminator who passes the appropriate information to subordinates, and a spokesman who sends s information to people outside the unit. Decisional roles include

entrepreneurial action to initiate new development projects based on the information received from the monitor, disturbance handling, which is responding to different pressures and problems, resource allocation decisions, and the negotiator duties and routines (Mintzberg, 2009). Within emergency management, the decisional roles play a critical part in all management functions (Cosgrave, 1996).

By distinguishing the roles, it is possible to better understand the varying nature of tasks inside and outside the units of an organization.

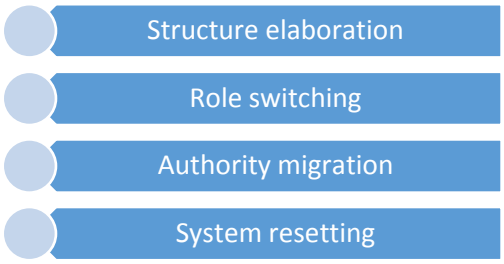
Within emergency management, a specific set of managerial roles have been established. Within the ICS, five major management roles are pinpointed: command, planning, operations, logistics and finance/administration (Lindell et al., 2005). There are also sector-wise roles as a standard NATO structure followed in general by the police. Within aviation and the maritime domain, there are dedicated standards for SAR operations (the IAMSAR manual). Both the governments and the units have to align their operations to these rules set by the International Maritime Organization (IMO) and International Civil Aviation Organization (ICAO). The IAMSAR Manual identifies and discusses four main coordinating roles – the SAR Coordinator, the Search and Rescue Mission Coordinator, the On Scene Coordinator and the Aircraft Coordinator (IMO, 2016a, b). Main tasks and responsibilities of maritime incident response evolve around these roles.

For the Arctic, we may find that these roles are not sufficient enough to deal with the increased complexity and dynamism. Tailor-made roles are thus in demand.

Restructuring Mechanisms

While managerial roles refer to a set of certain types of actions, the coordination mechanisms refer to a set of rules and practices to guide the action procedures (Bigley & Roberts, 2001; Buck et al., 2006; Bharosa et al., 2010). An important element in high complexity environments is to avoid system rigidity. Bigley & Roberts (2001) refer to the structuring mechanisms that represent a set of procedures for assembling and reassembling various organizational elements into a variety of configurations. In particular, they highlight four basic processes; structure elaboration, role switching, authority migrating, and system resetting (Figure 2).

Figure 2. Types of structuring mechanisms (Bigley & Roberts, 2001).



Such techniques are required in order for an organization to cope with a serious situation not expected and planned for (Mitroff, 2004). In such situations, also described as "black swans" and in situations where the complexity of the environment may create a high degree of uncertainty, procedures may prove useless and persons who are qualified for one type of action may have to take on other roles. Bigley & Roberts (2001) state that the system in use must be able to expand and contract, change strategic orientation, modify or switch tactics as an incident unfolds. Because

of the fast-changing working conditions of an emergency, including e.g. possible lack of broadband communication capacities, polar lows etc., coordinators may have to rearrange their roles, authority structures and procedures (Andreassen et al., 2018).

Thus, the coordinative mechanisms in emergency management have to be adapted to the complexity of the disaster response (Buck et al., 2006). Borch & Andreassen (2015) claim that in high complexity – high volatility environments like the maritime Arctic, there is a need for additional coordination roles and mechanisms incorporated into the standard organizational structures such as the ICS, most importantly to deal with contextual complexity and to allow improvisation.

To understand the dynamic balance of management during incident response, when two or more organizations with different managerial systems are involved, it is important to look into the implemented command systems, the set of managerial roles, and structuring mechanisms that guide these roles and functions. Structuring mechanisms influence roles flexibility and thus the inter-organizational operational action pattern and the hierarchy of the task force.

Methodology

This study builds upon in-depth case studies of four ship fire incidents that include the response of Maritime Incident Response Group (MIRG) teams or other firefighting efforts. We examine the following incidents: *Britannia Seaways, Nordlys, Le Boréal*, and *Norma Mary*. These are used as illustrative cases of high-risk events, which have potentially serious consequences for people and for the environment. Data has been gathered from both primary and secondary sources including incident reports, evaluation reports, conference presentations, interviews and examination of standard operating procedures.

The context with weather factors, crisis complexity in terms of challenges experienced by the involved actors, as well as the interdependences between them, are linked up to reflections on the command system, managerial role set, and the structuring mechanisms implemented.

Data

The Maritime Incident Response System

International conventions and standards for maritime and aeronautical SAR services are set by the International Maritime Organization (IMO) and International Civil Aviation Organization (ICAO). The International Convention on Maritime Search and Rescue (IMO, Hamburg Convention) and the Convention on International Civil Aviation with its Annex 12 (ICAO, Chicago Convention), provide the rules and regulations for SAR services. The International Aeronautical and Maritime Search and Rescue Manual (IAMSAR Manual), published by the IMO and the ICAO is based on the Hamburg Convention and the Chicago Convention. The IAMSAR Manual contains practical guidelines for the organization of maritime and aeronautical SAR, mission coordination, operations of search and rescue units (SRUs) and provision of SAR-related training. The manual is not binding but provides internationally accepted foundation for the appropriate provision of maritime and aeronautical SAR services (IMO and ICAO, 2016a,b).

Other international agreements relevant to maritime SAR, are the International Convention for the Safety of Life at Sea (SOLAS), the International Ship and Port Facility Security-code (ISPS)

and the STCW Convention – International Convention on Standards of Training, Certification and Watchkeeping for Seafarers, and the Polar Code.

The IMO's recently adopted International Code for Ships Operating in Polar Waters (Polar Code) is *"intended to cover the full range of shipping-related matters relevant to navigation in waters surrounding the two poles – ship design, construction and equipment; operational and training concerns; search and rescue; and, equally important, the protection of the unique environment and eco-systems of the polar regions"* (IMO, 2017).

For the Arctic region, the eight Arctic countries have signed an Agreement on cooperation on aeronautical and maritime search and rescue in the Arctic under the auspices of the Arctic Council in 2011 (Arctic SAR Agreement). The objective of the agreement is to "strengthen aeronautical and maritime search and rescue cooperation and coordination in the Arctic", and each member state has a particular SAR area of responsibility.

Norway's maritime SAR responsibility goes beyond its territorial-, economic- and fishing zones and covers a very extensive area. The Norwegian Rescue Services carry out the Norwegian duty according to the relevant international SAR agreements. The Norwegian maritime SAR service in Northern Norway above 65 degrees, hence in the Arctic maritime regions, is the responsibility of the Joint Rescue Coordination Centre (JRCC) Northern-Norway. The JRCC has at its disposal the dedicated AWSAR helicopters, and may mobilize whatever resources they find necessary including military and voluntary forces, and support from other countries. Emergency response agencies that are involved into incident response may belong to different institutions and have different jurisdictions as well as have different command, coordination and control structures.

Fire safety on board ships is governed by international maritime legislation. After the disastrous Scandinavian Star incident, the maritime authorities have implemented a number of measures, which have strengthened fire safety at sea. Fire safety on vessels is primarily dependent on precautionary measures taken aboard and the ship owner's emergency preparedness plans. According to the conventions of the International Maritime Organization (IMO), the vessel's own crew has to be able to start firefighting during an incident before receiving assistance from a land-based fire department. To support rescue measures and firefighting carried out by the ship's crew Maritime Incident Response Groups (MIRG) operated by the national fire departments have been trained for special maritime SAR situations and smoke diving on board vessels.

The Cases

Britannia Seaways - Western Norway

On 16 November 2013, fire broke out on *Britannia Seaways*, a ro-ro cargo ship that was on a voyage to the south from Northern Norway carrying military equipment, vehicles and a number of tank containers, and flatracks with jerrycans containing petrol and aviation fuel. Personnel from the armed forces were on board as passengers. Outside the Norwegian west coast, the weather deteriorated, with storm and high waves, resulting in severe rolling. The cargo lashing came loose and the cargo shifted. A fire broke out in petrol that was leaking from damaged jerrycans stowed on flatracks on the forepart of the weather deck (Danish Maritime Accident Investigation Board, 2014).

The ship's officers and own crew started a lengthy firefighting effort, assisted later by the military personnel. The master realized that there were 12 trained military passengers on board wearing

clothes well suited to withstand the cold and water. Some of the military personnel volunteered to assist with the firefighting efforts and together with the crew managed to contain the fire on the forepart of the weather deck. The Joint Rescue Coordination Centre in Stavanger requested to evacuate all non-essential persons on board the ship. However, in order to evacuate the passengers, the ship would have to change course and expose itself to severe rolling and wind. The master refused to attempt to turn the ship, because this would hinder the ongoing firefighting due to severe rolling, and the flames would be dangerous to the firefighters and the ship's superstructure because of the wind. The master assessed that it would involve a clear hazard to the ship and those on-board (Danish Maritime Accident Investigation Board, 2014).

Later a Norwegian navy frigate arrived to the scene and took the position as the on-scene coordinator (OSC). An offshore supply vessel with firefighting capacity had also been requisitioned by the shipping company's crisis management team. Firefighting efforts were joined by three firefighters from shore and a MIRG team with firefighters specialized in maritime incidents (Danish Maritime Accident Investigation Board, 2014). A report from the Bergen fire and rescue service (2013) stated that neither the emergency call centre nor the MIRG team were notified of the other three firefighters that joined the firefighting efforts, causing some confusion both on board the vessel and with the strategic management of the fire and rescue services on shore as they had not included the additional resource in their plans.

This incident involved several stakeholders, both civilian and military, and inter-organizational action between the master of the vessel, the firefighters, and operative on-shore coordination. The vessel captain's experience-based decision-making and evaluation of bad weather and its effects for firefighting was crucial. Furthermore, the captain's ability to find flexible solutions, such as utilizing passengers from the armed forces in firefighting, maintaining command, as well as keeping the on-scene coordinator, the vessel owner, and the JRCC informed, contributed to a positive outcome (Danish Maritime Accident Investigation Board, 2014). The traditional commander role of the SAR mission coordinator on shore and the on-scene-coordinator was overruled by the vessel captain who made his decision based on the prevailing conditions. He therefore took the role of incident commander himself with a flexible command structure including the military forces on board.

The harsh weather and wave conditions were the cause of the fire, and caused changes in the traditional command system and the managerial roles set for this type of operations. The captain decided against the requests by the SAR mission coordinator as well as the helicopter captain based on his own situational awareness and mobilization of extra resources on board. He also took charge of the next steps of the firefighting action by directing the navy frigate and the professional MIRG team that came onboard. The captain and the crew at Britannia Seaways later received the IMO's medal for bravery at sea.

Le Boréal - Falkland Islands

On 18 November 2015, the cruise ship *Le Boréal* on a route to Antarctica was near Falkland Islands when a fire broke out in the engine room, which led to a complete loss of power. The fire broke out due to a mistake by one of the engineers. The weather was bad, and the fire left the ship adrift in gale force winds and high waves. The cruise ship had 347 people on-board. Firefighting measures were started. However, as the vessel was drifting towards the coast without power and

there were smoke all over the cabins, the master decided to drop the anchor and evacuate all passengers and non-essential crewmembers (IMRF, 2016a; BEAmer, 2016).

The passengers account very chaotic circumstances on board with a crew who were uncertain about their roles and responsibilities; *"Total chaos on board according to passengers in Stanley. Smoke in the accommodation, lifeboat embarkation chaotic and uncontrolled, lifeboats not manned with experienced crew."* Some of the passengers were launched into life rafts although there was life boat capacity for all passengers (Walker, 2015).

The Antarctic region has many of the same challenges as the Arctic region when it comes to emergency response. Distances are often vast, resources are scarce, water is cold, sea is rough, capacities to host and accommodate passengers are limited, and communication lines and networks might not be available. Luckily, *Le Boréal* was close to the British naval base at the Falkland Islands. The Maritime Rescue Coordination Centre (MRCC) Falmouth in the UK, who had received the initial distress alert, coordinated the response. As the island is remote and sparsely inhabited, the response required full-scale marine, air and land response assets from the Falkland Island government, military and private sector. Three helicopters, a fixed wing C130 aircraft and 4 vessels were sent to the incident site. At first, the on-scene coordinator role was given to an OSC on board the first helicopter to arrive to the incident site, but was later transferred to the C130 aircraft so that the helicopter could concentrate to the rescue operation and go refuel. *Le Boréal's* sister ship, *L'Austral*, was also in the vicinity of the incident site and had capacities to take on passengers from *Le Boréal*. (IMRF, 2016a; BEAmer, 2016) Because of the high waves, there were problems with rescuing the passengers from the tenders/life boats onto the frigates. Thus, the frigates had to tow the life boats into calmer waters. This was a tough experience for the passengers on board.

The initial landing point was established at Cape Dolphin and the helicopters took some passengers there. Simultaneously, a reception center was being established at Mount Pleasant military base and *L'Austral* was boarding passengers to be taken to Port Stanley. This caused some confusion with accounting the passengers and identifying their whereabouts. The MRO operation was successful and there were no injuries to the passengers or crew (IMRF, 2016a; BEAmer, 2016).

Regarding the managerial roles, there was some obscurity with the roles of the officers and crew onboard the ship and the life boats during the evacuation. In addition, the rescue operation was very demanding and called for improvisation by the rescue units. This in turn caused some confusion about the whereabouts of the passengers that were brought ashore. This is normally a task for the on-scene coordinator to control. The Commander of British Forces in the South Atlantic Islands characterized the emergency evacuation as *"an extremely complex and hazardous rescue operation in difficult conditions."*

Norma Mary - Barents Sea

Distance to resources is one of the biggest challenges in the Arctic limiting the number of assets that can be sent to a rescue operation, and therefore the ship's own efforts with fire safety are crucial. In the case of *Norma Mary*, a fishing trawler sailing in the Barents Sea in the High Arctic had a fire in the factory area on-board. A coast guard vessel with firefighters was 10 hours away and two helicopters four hours away at Svalbard. Due to the incident site being so far away, the helicopters would have to be ready to refuel on the way to the site. Another fishing vessel was two

hours away from *Norma Mary,* and was asked to assist and follow *Norma Mary,* if necessary. The crew of *Norma Mary* started firefighting efforts however the fire was causing heavy smoke, which prevented the crew from properly inspecting the situation. The master, however, assessed that there was no danger for the crew and no need for evacuation. The master also requested that the other fishing vessel following *Norma Mary* could be released from this duty. The other vessel was asked to follow Norma Mary until meeting with the coast guard vessel regardless of *Norma Mary's* master's assessment.

The coast guard vessel reached the distress vessel after 10 hours. After boarding *Norma Mary*, the firefighters from the coast guard vessel found that the fire had been put out but discovered water in the factory area. The fishing vessel did not have suitable pumps, so pumps were brought from the coast guard vessel. After all efforts, the master wished to return to Iceland for repairs (JRCC, 2015).

In this incident, the crew onboard was totally without support for many hours, but managed to cope on their own. This incident could have had serious consequences, if the fire on board was bigger and the coast guard vessel not sailing conveniently in the area. Ship fires often spread fast, and the distance in this case to any assisting resource was extremely long. This highlights the increased complexity of response, the lack of resource availability in the High Arctic and the vessel's own ability to respond to the fire.

Hurtigruten Nordlys - Ålesund, Norway

The coastal cruiser *Nordlys* from the company Hurtigruten faced a dramatic engine fire near Ålesund, Norway. The weather conditions were fair and the incident site was close to the Ålesund harbor. There were plenty of resources available however the ship fire and the complexity of the incident itself had significant consequences for human life and potential consequences for environmental as well. *Nordlys* was approaching Ålesund on 15 September 2011, when there was a fire in the engine room, which caused both the main engine and the auxiliary engines to stop. Two crewmembers went missing and the captain did not dare to release the fire exhaustion system as he did not know the location of the missing crew. One the missing crewmembers was the chief engineer who plays a vital role in the contingency management organization. The two missing crewmembers both died and two suffered serious injuries. Seven other crewmembers suffered minor injuries. The auxiliary generator failed and the ship faced total black out making firefighting impossible.

A rescue cutter close by heard the MAYDAY call, and went to assist *Nordlys* with emergency towing. The ship was towed to Ålesund harbor and the passengers were evacuated by launching lifeboats. All the 207 passengers on board were evacuated without any physical injuries. A coast guard vessel was appointed as the on-scene coordinator for the SAR operation. As the vessel was being berthed, the starboard stabilizer fin was pressed through the hull, which flooded the cargo holds with water. *Nordlys* developed a 20 degrees list, nearly capsizing, and all personnel onboard had to be evacuated. The hole was later fixed and water pumped out, stabilizing the vessel (AIBN, 2013).

The AIBN's investigation (2013) concludes there were inadequacies in job specifications for equipment and fire safety on board the vessel. The safety management system also lacked procedures for training to deal with loss of personnel. The loss of personnel and injuries were

caused by the crew being trapped by heat and smoke with limited possibilities for evacuation. The personnel also lacked training for such situations, which is why some safety critical tasks were not carried out. Among other things, the air supply and fuel supply were not shut off. If the supply of fuel and air had been shut off, the fire could have died down by itself (AIBN, 2013).

As the incident happened near the Ålesund harbor, plenty of resources including the police, fire and rescue service, coast guard, rescue vessel, health personnel, private sector and other rescue crew could be mobilized rather quickly to the harbor (AIBN, 2013). Many of these authorities were involved in the response efforts at the same time, and the JRCC Stavanger led the operative coordination for the SAR efforts. The coordination of the joint response, both operational and tactical, was fluent and effective in this incident. As the vessel was close to the harbor, the fire and rescue services had a chance to gather their whole management team and the MIRG team from Ålesund to the harbor, as well as later send a liaison officer for the fire incident commander together with the MIRG operation commander to the bridge, which would be unusual in normal MIRG operation at sea. This however provided more flexibility and better coordination of the command and control system. The MIRG crew was assisted by the vessel's own smoke divers and a MIRG team from Bergen was also on stand-by in Ålesund. MIRG crew boarded the vessels and found the two bodies while inspecting the spaces and conducing rescue efforts for the missing crewmembers.

In remote areas, heavy weather, and in Winter time such a situation would have been even more dramatic. Luckily, the vessel was close to a town with significant resources available. The incident showed that only having trained for specific roles in the vessel emergency response management team and not having others prepared for entering into this role hampered the initial response. Onshore, the response teams were faced with a situation they had not experienced before. This called for improvisation in the organization. Among other measures, they introduced a new role as liaison together with the MIRG team onboard the vessel to facilitate internal communication. They also needed additional advisors to assess the risk of the ship capsizing. The case shows that improvisation as to the number and types of roles as well as having backup for important managerial roles is crucial.

The Command Systems

Search and rescue (SAR) operations, including firefighting at sea, are conducted in accordance with defined procedures in the International Aeronautical and Maritime SAR Manual (IAMSAR Manual). According to the IAMSAR manual, the SAR system has three levels of coordination; the SAR coordinator (SC), the search and rescue mission coordinator (SMC), and the on-scene coordinator (OSC). The SAR coordinator (SC) has the overall responsibility for establishing, staffing, equipping and managing the SAR system including legal and funding support for the agencies but are not normally involved in the SAR operations (IMO and ICAO, 2016a). The Chief of Police, and ultimately the Ministry of Justice and Public Security, act as the SAR coordinator in Norway. The operational level coordination is conducted by SMCs at the JRCC operational center under authorization by the Chief of Police. The SMC will be in charge of the overall coordination of incidents and allocation of all necessary resource. The tactical level coordination during operations is delegated to the first vessel on-scene and later to a larger vessel as an OSC. The OSC task is to rescue people and at the same time communicate with the distress vessel, report to the SMC, coordinating the search and rescue patterns of the other vessels, and keep control with the

air activity. In reality, the OSC role has to be performed by several people in order to be properly handled. The IAMSAR manual does not address these aspects with a more detailed command system.

Other tasks of the OSC include modifying the action plan received from the SMC based on the prevailing conditions, ensuring that the operations are conducted safely, maintaining a detailed record of the incident, keeping track of the number and names of the rescued people, and providing situation reports to the JRCC. The OSC will liaise closely and act as support for the vessel master (IMO and ICAO, 2016a). The Britannia Seaways case shows that the captain at the distress vessel may take a vital role in the grey zone between the SMC and the OSC, taking over the command based on the prevailing conditions.

The relation between an OSC and SMC is always a joint-effort and a mutual discussion on how much responsibility the OSC can handle and the best way to coordinate the incident. This is based on OSC observations and situational reports. There could be incidents where the SMC has better overview over the situation because of available technology like drone cameras, satellite images and other sensors where the SMC may take on more of the OSC role. Also, the other way round. In the High Artic, the communication north of 70 degrees is occasionally breaking. If the OSC becomes aware of a distress situation directly and communications cannot be established with the JRCC, the OSC may have to assume some of the SMC duties and actually govern the whole operation, including shore mobilization (IMO and ICAO, 2016).

In maritime incidents involving a passenger vessel, it is important to determine the responsibilities and authority of the SAR agencies and the master of the distress vessel (Finnish Border Guard, 2014). The distress vessel management includes the master of the vessel and his officers comprising usually of chief officer, chief engineer, bridge team and the safety crew. Each will have dedicated tasks on the muster list and competences to handle various emergencies. In the Polar Code, there are demands for additional Polar Code courses for the captain and deck officers focusing on safe navigation in polar waters. However, they do not have an obligatory education and training as to emergency contingencies and response in Arctic waters.

The master of the distress vessel is responsible for the vessel and passengers' safety for all types of acute emergency and preparedness incidents, in which the vessel is involved. The master coordinates rescue measures on board a vessel in distress, including giving information and orders to external groups such as the paramedics, the MIRG teams, chemical divers, etc. The master also needs to assess the conditions of the vessel and the incident site in order to make the best decisions for passengers' safety. The Britannia Seaways case illustrates a successful outcome of the master of the distress vessel being in charge. The role sharing mechanisms and the authority between the distress vessel captain and the SMC is a challenge.

The fire and rescue services in Norway follow the Incident Command System which has a different organizational model than the IAMSAR manual. The Incident Command System will be used in mass-rescue operations involving for example the fire and rescue brigades and oil spill response, such as during the *Nordlys* ship fire. Firefighting and MIRG operations at sea will be coordinated from the JRCC following SAR procedures and command system. The MIRG operation commander acts under the authority of the SMC and is responsible for reporting to both the SMC and the OSC. However, the organizational structure will be different at tactical level. The staff and operations at the fire department will follow the ICS structure. During the *Nordlys* incident, the

fire department management gathered in the harbour next to the vessel following the ICS, which increased the situational awareness and efficiency in coordination (DSB, 2011; IMO and ICAO, 2016b). They also introduced liaison and advisory roles in the rescue team to facilitate good communication between the various groups involved.

Similar to any maritime incident, if a fire on board a vessel can be tamed by the vessel crew and danger to the crew and passengers is small, the ship owner is responsible for coordination of the incident. The ship owner can request some assistance such as advice, but may handle the overall coordination while the situation is under control. If the emergency evolves to the point where the ship owner and the ship crew cannot handle the fire, the coordination will be passed to the JRCC and the MIRG crew will be alerted, if necessary (Salten Brann, 2011; Finnish Border Guard, 2014; 2016). Meanwhile, the crew will continue the firefighting measures, and evacuation if needed. Once aboard the vessel, the MIRG team will start firefighting and other MIRG measures led by the MIRG operation commander in cooperation with the captain (Finnish Border Guard, 2016).

Discussion

Arctic Challenges and Inter-Organizational Action Patterns

Arctic maritime operations pose a difficult environment for emergency response, including firefighting operations. Major ship fires or explosions can have significant consequences for both people and the environment, especially in the Arctic where response is challenged by resource scarcity, long distances, difficult weather conditions and poor communication connections.

One of the major challenges with ship fires relates to the decision-making on whether to bring in external firefighting assistance and how long the firefighting measures should be carried out before the passengers are evacuated. In the Arctic region, vast distances, long response times and rough weather conditions may create extra uncertainty about the time span before rescue is possible. Particular attention also has to be paid to the demands that the Arctic environment with ice and icing poses to the firefighters' equipment, operations, training, and safety (Finnish Border Guard, 2014).

As a fire tends to spread fast, dispatching MIRG teams might not be a valid option in the North because of long response times. Fire safety on a vessel is primarily the responsibility of the ship owner and the captain. Fire safety depends on the presence of relevant equipment and countermeasures on board, the effective functions of the ship's preparedness system, and crewmembers' abilities of fire prevention, firefighting, smoke diving, search and rescue, and evacuation. This is especially true for the Arctic waters. However, the need for additional capacity for the crew to be able to operate on their own with firefighting for a longer time period is bad weather conditions, is not included in the Polar Code.

The *Nordlys* and *Britannia Seaways* incidents happened quite close to the shore and relevant resource assets, making it easier to deploy the MIRG team and firefighting assistance. If put in the Arctic context with a longer distance to shore, rough seas, and cold conditions, as it was during the *Le Boréal* incident, deploying MIRG teams would be more challenging, thus leaving the main responsibility to the vessel crew. This was well demonstrated in the *Norma Mary* case. While the fishing vessels own crew had the fire in control most of the time, in bad conditions with Norma Mary's inadequate equipment, the firefighting efforts might not have been so successful.

Since MIRG operations are part of the SAR system, MIRG procedures and the chain of command is very clear in small scale events. However, in major multinational incidents, there will be challenges in understanding the leadership between various teams, their organizational cultures, structure and procedures. Usually, the fire and rescue services follow the ICS model that differs somewhat from the SAR system. The ICS has more functions and roles within the operational and tactical management and can accommodate various organizations and incident commanders in its unified command. The ICS is quite flexible, but on the other hand can cause some confusion, for example, with which functions are established and who is in command, especially if the incident involves many regions, fire brigades, agencies and other nations that have their own versions of the ICS. The SAR system in turn can be quite overloading for the persons in charge of operational and tactical command as they are put under a lot of pressure and responsibility. However, the command line is clear and established similar in all countries as it is based on the IAMSAR system. Because the MIRG teams have to know both the ICS system for their daily fire and rescue service operations and the maritime SAR system for MIRG operations, education and competence building in both of these areas is very important. In order to fully understand the chain of command, the MIRG teams, especially the operation commander, should be familiar with the SAR system in addition to the ICS.

Flexibility of the On-Scene Coordination, Managerial Roles, and Structuring Mechanisms

The incident with *Britannia Seaways* involved several stakeholders, both civilian and military, and inter-organizational action between the master of the vessel, the firefighters, and operative on-shore coordination. The experience-based decision-making of the on-board management and evaluation of bad weather and its effects for firefighting was crucial for the successful response efforts. Furthermore, the ship management's ability to cooperate, and find flexible solutions and procedures, such as making decisions based on knowhow and keeping relevant parties including the on-scene coordinator outside the ship informed, contributed to a positive outcome (Danish Maritime Accident Investigation Board, 2014).

In terms of the flexibility of the system, the mechanism for structure elaboration can be referred to when discussing demanding operational circumstances. Role switching in *Britannia Seaway*'s case was also an important mechanism, as the ship's crew managed to maintain command and were able to coordinate efforts utilizing the experienced passengers. The operation was successful, and the OSC position was given to a Norwegian navy ship in later stages of the operation. This calls for further attention to informational roles, where the coordinator assesses the prevailing environment and receives information and orders from the on board management at the distress vessel.

In the case with *Le Boréal,* at first the on-scene coordinator role was given to an OSC on board the first helicopter to arrive to the incident site but was later transferred to the C130 aircraft so that the helicopter could concentrate to the rescue operation and go refuel. Distance and the scarce resources in this case also had a direct influence on the interdependence between all the stakeholders as well as the flexibility of the OSC role. As the aircrafts cannot stay airborne indefinitely, there had to be a transfer of control in the middle of the operation. The OSC and the

MRCC should consider sequencing tasks, or dividing responsibilities in order to maintain continuity in or smooth transfer of command, control and understanding of the situation (IMRF, 2016b).

The incident command allocation is highly dependent on the efficient mechanisms of role switching and system reassembling. Coordination between the government authorities, private operators, local authorities as well as dividing responsibilities is extremely important in mass rescue operations and point to the need of a comprehensive MRO plan and standard operating procedure, for example in this case, in establishing evacuation reception centers. The procedure for assignment and reassignment of personnel to different positions according to the functional requirements of the situation is important in this case.

After boarding *Norma Mary*, the firefighters from the coast guard vessel discovered much water in the factory area with a risk for negative vessel stability. They had to mobilize for a new type of action, i.e. salvage of the vessel. This incident highlights the increased complexity of response and the need for multi-skilled crew in the High Arctic, and the vessel's own ability to respond to the fire. In such situation, mechanisms of structure elaboration and system resetting would be critical. On-scene command should be organized under demanding circumstances of scarce resources, and should be able to utilize the available structures, routines, and competences.

Another example illustrating the importance of role switching can be drawn from the *Nordlys* case. The decision-support system on the bridge included a checklist in the event of a fire. In an emergency, the chief engineer was to muster to the bridge and follow up the checklist. However, the chief engineer was one of the persons trapped in the engine room. According to the muster plan on *Nordlys*, the first mate was to take over the chief engineer's tasks in case the chief engineer could not perform his tasks. However, these procedures were not followed and several important tasks initially assigned to the chief engineer and first engineer were not carried out. This led to a deterioration of the situation (AIBN, 2013). In this case, the response flow was affected by unclear roles within the ship's own safety management and the ability to apply flexible command of responsibilities in a very stressful situation.

The *Nordlys* case also illustrates the importance of authority delegation mechanism. During the on-shore phase of the operation, the prevention efforts for possible oil spills were initiated. The police also established a unified command center for tactical coordination and prepared the harbor for response efforts. The priority will always be first on saving lives and conducting rescue efforts, and then handed over to the next responsible authority. According to the Norwegian Directorate for Public Security (DSB), there was some confusion over the ownership of the crisis after the JRCC, the captain and the fire services had completed their duties (Eikrem, 2012). The rescue sub-centre, which usually gathers operative leaders from each relevant organization for coordination, was not established since the police led their response and held communication from the staff room. In this case, the decision for not following standard procedures somewhat affected a transparent communication and coordination between different authorities. System flexibility and alternative procedures may cause confusion in roles and responsibilities with various stakeholders if not taken to the right level of decision-making or if all parties are not aware of the deviation from standard procedures.

Conclusions

In this paper we have examined the inter-organizational coordination patterns and the command structures implemented in the context of Arctic emergency response. The complexity of coordination relates to the various organizations involved with somewhat different command systems and their reciprocal dependencies in a crisis situation. We have highlighted the need for introducing inter-organizational restructuring mechanisms allowing flexible on-scene coordination of emergency response to meet the challenges of the Arctic environment.

Large-scale maritime SAR incidents in the Arctic may result in an overload in the normal emergency response system. Limited resource availability, resource-consuming mobilization time and the lack of experience in these kind of incidents in the High Arctic context may put a heavy strain on the management levels. Deploying specialized services in densely populated areas with high predictability, sufficient capacity and good communication, is potentially fast and efficient. The deployment of sufficient task forces in the Arctic may mean operation in unknown territory and cooperation with different actors than normally trained with. Also, the units in distress have to manage on their own for a longer time, and have to help out the professional forces with their duty. This study has shown that for the units in distress, managerial roles connected to information sharing are crucial for a positive outcome. The involved coordinators should both monitor the operational environment, and share information that would help the overall situational awareness in spite of limitations in information exchange capacities. Flexibility in the decision-making process is important at all management levels including finding new resources and solutions, as well as adapting standard operating procedures to the prevailing environment and using local knowhow and resources.

Role flexibility, re-planning capability, and authority delegation are critical prerequisites for an efficient management response in the Arctic. The mechanisms for assembling and reassembling task forces, role switching, authority coordination and system resetting are also important mechanisms that provide command system flexibility. The capability of role switching is important for all actors involved in the maritime incident response. However, these demands call for further education and competence building in the maritime SAR system for authorities, ship owner management, and the vessel crew.

In this study, we have built upon few illustrative cases. There is a need for quantitative studies demonstrating the contextual elements and their influence on the managerial roles and structuring mechanisms. In particular, one should elaborate on the resource re-configuration with a mix of capacities from various sources, including the resources from neighboring countries. As for the managerial roles, improvisation beyond the standard authority responsibility and role switching among the incident commanders, should be further focused on.

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