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Comprehensive approaches to cooperation for organisational resilience to promote safety and security in the Arctic

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Abstract

Cooperation on the Arctic domain between Russia, the United States, Canada, Denmark, Iceland, Norway, Sweden, and Finland has been quite peaceful with little geopolitical tension (Pezard et al., 2017). Plans to prospect Arctic natural resources (Haftendorn, 2016) however raise challenges and uncertainty among security organisations on this domain. Reforms to global governance systems have been attempted, but new bodies mainly focus on specific challenges and remain in silos. The findings of this study indicate that coherence and constructive collaboration among global and regional policies, actors and institutions on all levels are needed in order to build resilient organisations for safety and security. Effective multilevel networks for knowledge and information sharing by all stakeholders, policy makers, academics and education providers, authorities, non-state actors, and successful collaboration between these networks, can contribute to resilience in the context of Arctic safety and security. This study aims to answer for research question: How can collaboration networks co-create knowledge and share information on organizational resilience to promote Arctic safety and security?

The research methods of this study include triangulation of participatory observation and expert interviews collected between years 2015 to 2018. The contribution of this paper is that understanding the dynamics and trends in the Arctic domain provides background for designing new

solutions to build resilience organizations in the Arctic including co-creation and collaboration can support best practices that support the adoption of new solutions. Developing multilevel and effective information sharing networks, can promote better situational awareness and decision-making to benefit organizational resilience building in the Arctic domain.

Key Words: Resilient organizations, Arctic governance, Collaboration networks, Co-create knowledge transfer, Information sharing, Arctic safety and security

1 Introduction

Economic and human activity in the Arctic is increasing because the climate there is warming. The Arctic Ocean is estimated to become practically ice-free during summers by 2050 (Heikkilä & Laukkanen, 2013). Global climate change can open new challenges as well as possibilities in the Arctic. Drilling for natural resources is increasing, as are passages on new sea routes that cut distances between the Pacific and Atlantic oceans. Impacts of this rapid climate change have resulted in many major natural hazards, mostly slow onset, such as rising sea levels or acidification of oceans, threatening coastal communities and infrastructure with coastal erosion, subsidence, or permafrost thaw (Barnhart et al., 2014). “Regardless of the risks involved, these Arctic routes and possibilities are a hot topic and shipping in the Arctic will most likely increase in the future” (Salokannel, Knuuttila & Ruoslahti, 2015: p. 2). Eicken et al. (2016) direct attention to the coast of the Arctic Ocean, where ice represents a major hazard, and the exposure to risk for human activity is at a maximum. Emergency response frameworks may not be effective in addressing the hazards of the Arctic (Eicken and Mahoney, 2015; Huggel et al., 2015). Slow-onset risks can further increase exposure and vulnerability of communities over time. Security in international

relations has been generally considered on a national, trans-regional or global scale and in terms of governance coalitions, interests or macroeconomic institutions (Coaffee and Wood, 2006). From the point of view of Arctic safety and security cooperation between authorities is seen as an area needing development: “The regulations concerning the safety of shipping, Arctic navigation services, and the readiness to prevent various accidents and to act in accident situations are badly inadequate... Surveillance arrangements in the Arctic sea area and cooperation between the authorities can be seen as an area of development ...“ (Finland’s strategy for the Arctic region, 2010, p. 28). This article focuses on rethinking the safety and security on the Arctic domain, which is seen as extreme context. The study aims to, in particular, highlight responses to current and future safety and security challenges, through building resilience of safety and security organisations. Information sharing is a useful way to communicate operational security experience between systems stakeholders to enable their defence against possible system attacks or incidents and to improve their defensive posture, by proactively addressing possible attacks. The role of information and knowledge sharing leading to innovation process of co-creation in resilience of safety and security organisations is further analysed in this study.

A balance between economic growth, human development and environmental considerations is challenging actors (Tennberg, 2012). Commitment from and multilateral cooperation between states, non-governmental organisations, businesses and individual opinion leaders are a proven way to tackle some of the wicked problems of the North (Ministry of Foreign Affairs, 2018). For innovation, inter-organisational collaboration with suppliers, customers, universities, institutions and other organisations is seen as core (Luoma et al., 2010). This article aims to find the answers for the research question: How can networks share information and knowledge better to build co-creation innovation processes of organizational resilience to promote Arctic safety and security?

The next section looks at how collaboration structures are discussed in academic literature, followed by sections for Methodology, Results and Conclusions (including contributions).

2 The Arctic domain – an extreme context

“The Arctic is an environment where uncertainty and unpredictability are present. Hence, not all can be described in best practices to be followed neither can all risks be reduced, at least not yet. The human element is still needed to get the job done in all circumstances from normal operation to handling incidents and surviving accidents. IMO states that, safety culture should take root in the professionalism of seafarers, where competency, training and attitudes are important” (Salokannel, Ruoslahti & Knuuttila, 2018, pp. 48).

2.1 Arctic Activity

The Arctic is rapidly emerging as a political component, because of the rapid reduction in the Arctic sea ice cover, especially noticeable during the summer months. The Arctic is opening up to the exploitation of its substantial natural resource bases and new maritime routes, and some 4 million people live in the Arctic (Käpylä & Mikkola, 2015). The climate of the Arctic is warming (Heikkilä & Laukkanen, 2013), as the period from 2005 to 2010 was the warmest ever measured in the Arctic. The extent of Arctic sea ice has been lower than ever (European Commission, 2012). This rate of the warming and the decrease of the ice-cover have been surprisingly rapid. Thus, there is increasing strategic, political, and economic interest to the area. The Arctic Ocean could, end up, like the Baltic Sea around Finland today, freezing in winter and melting in summer (Heikkilä & Laukkanen, 2013; Gascard, 2014).

Russia's Arctic gateway, its Northeast Passage sea route is a good testament of the increasing interest toward the region. Traffic is increasing (Zalyvsky & Eduardovna, 2015; Guy & Lassarde, 2016). Russia is also taking measures to reduce risks. Russia has a mandatory piloting scheme on the Northeast Passage, where vessels are aided by nearly two dozen Russian icebreakers and protected by a string of 10 up-to-date search-and-rescue centres along the route. (Guy & Lasserre, 2016; Gascarde, 2014). Over 200 transit traffic vessels passed through the Northeast Passage on Russia's Northern Sea Route between 2010 and 2014 (Guy & Lasserre, 2016). Besides this transit traffic, there is increasing traffic within the region transporting supplies to local industry and communities (Gascard, 2014). The fees that shippers pay go toward the costs of improvements to the sea route. This increasing maritime transportation is stimulating inland development (Heininen, et. al., 2014; Lipponen, 2015). The Arctic holds 30 % of undiscovered oil and 30% of undiscovered gas supplies. These are offshore and in depths of under 500 meters (US Geological Survey, 2011). This possesses safety and security challenges on the level of maritime safety and security, coast guard functions (Guy & Lasserre, 2016) and individual vessels (Salokannel, Knuuttila & Ruoslahti, 2018). Arctic tourism on cruise ships is increasing, despite the very limited monitoring, surveillance, and search and rescue (SAR) capabilities (Gascard, 2014). Any possible rescue operations are extremely difficult. The northern coasts of Russia, Alaska, and Canada are largely uninhabited and have very few harbours. It takes time to get help. There have been few international navigation aids or common risk analysis in coast guard functions (Salokannel, Knuuttila & Ruoslahti, 2018; Ruoslahti & Knuuttila, 2016), "activities in the Arctic are increasing. This puts a focus on proactively developing the levels of security and safety measures in the area. The Arctic and the extreme environments are remote and hostile - a first response must come fast" (Ruoslahti & Knuuttila, 2016, p. 470).

One barrier on the Arctic domain is related to diplomatic relations, global governance and trust building among the involved nations. “However, the activities of multilateral organisations involve significant challenges and conflicts of interest” (Ministry of Foreign Affairs, 2018, p. 11). Issues which matter to people are central to them. Arctic organisations need to find the suitable arenas of interaction to connect with people, while “the intentions of the actors in relation to the issue discussed are not always clear” (Vos, 2017, p. 20). The importance of the human element, with a safety culture in maritime affairs including “risk evaluation, preparedness, clear communication and direct involvement of the crew and their employer” (Guy & Lassard, 2016, p. 302). Salokannel, Knuutila & Ruoslahti (2018) note that crisis management prevents harm and damage. Communication goals are 1) empowerment, 2) understanding, and 3) cooperation. Every crew member of a ship should be empowered to actively participate in the monitoring the safety needs of the ship. Understanding company guidelines and formal regulations is also important. Successful cooperation is demonstrated as efficient response to changes in the environment. “Team agility and rapid reaction, for example, are important to efficiently respond to the changing needs in the ship’s environment” (p. 11), and continuous evaluation, preparedness, and best practices promote accountability and retention of lessons learned.

2.2 Arctic cooperation

One way to react to the increasing activity in the northern areas has been the establishment of the Arctic Coast Guard Forum (ACGF) (Arctic Coast Guard Forum, 2018). Another example is the cooperation between Norway, Sweden, Finland, and Russia based on the Agreement between the governments in the Barents Euro-Arctic Region on Cooperation within the field of Emergency Prevention, Preparedness and Response (Barents Rescue, 2015, p. 5). International inter-agency cooperation can “speed the process of finding robust working solutions and services that can

provide a range of uses for different authorities” (Ruoslahti & Knuuttila, 2016, p. 470). Two important documents are the *Arctic Council agreement on Cooperation in Aeronautical and Maritime Search and Rescue in the Arctic* (Arctic Council, 2011) and the International Maritime Organisation’s (IMO) *Guidelines for Ships Operating in Polar Waters* (IMO, 2010). The polar code is a very significant development for Arctic ship operations. It sets levels for training of officers and crew, and recognizes that risks vary in relation ice-conditions. Guy and Lassard (2016) note that “Experience also shows that beyond proper rules, their implementation is a crucial element, as well as are the means to enforce compliance” (p. 301). The Polar Code offers guidelines in the development towards proactive safety and security on both the level of coordinated coast guard functions, and on the level of any single practitioner (e.g. vessel) operating on the Arctic domain. ACGF is one welcome body, where work involving the coast guard functions in the vast, cold and harsh Arctic regions are coordinated. This development is well in line with European Member States seeking integrated cross-sectorial ways to respond to the various challenges across the entire European maritime domain (European Coast Guard Functions Forum, 2014).

There is still little traffic on the Northeast Passage, but it is increasing. Guy & Lasserre (2016) note that the Northeast Passage between Europe and Asia is up to 40 % shorter than the route through the Suez Canal. The need to cooperate and share information that benefits the security and safety of living, transport, and economic use in the Arctic environment is growing (Ruoslahti & Knuuttila, 2016). The Ministry of Foreign Affairs of Finland (2018, p. 11), writes that “The escalation of climate change may lead to growth in maritime transport and the exploitation of Arctic hydrocarbon reserves” and that this is attracting the interest of new, traditionally non-Northern, actors, such as China and other Asian countries. Buba Bojang (2018) notes the need for collaboration, or joint development, between States to balance between the growth of economic activity and managing

the environment. “The Russian maritime Arctic and the offshore waters of the Arctic Norway are the two regions which will likely witness increasing marine traffic in the decades ahead” (Brigham & Hildebrand, 2018, p. 8).

The Arctic domain is seen, within research community, as being multidisciplinary and with sensitive phenomena and complexity (Iskanius & Pohjola, 2016). Multi-stakeholder impact assessments have shown that acceptance of developments and innovations within broader communities can be increased through well prepared tools and procedures for design, development and implementation processes (Rip & Schot, 1997, p. 251). The concept of Communities of Practice (CoP) is used among some researchers to provide a platform for social context for collective learning (Lave & Wenger, 1991).

2.3 Safety and security gaps in the Arctic

The Arctic search and rescue capabilities survey by the Finnish Border Guard calls for close practical cooperation between the many stakeholders to improve Arctic search and rescue capabilities. Besides severe cold weather, ice conditions and long distances, key challenges in the North are lacking infrastructure and resources, poor communications networks, capacity to host patients, unsuitable evacuation and survival equipment, and achieving situational awareness all pose major challenges for maritime safety and SAR in the Arctic environment. The authorities involved in Arctic SAR recognize the need to develop advanced information sharing between all stakeholders involved in SAR operations. Coast guards and emergency authorities should train jointly and systematically share lessons learned and innovation in technology. Improvements in

communications networks, navigation, healthcare services, and survival and rescue equipment, will be needed to improve SAR capabilities in the region. (Ikonen, 2017)

“Safety and security are a prerequisite for the growth and welfare of the Arctic communities and for viable and sustainable commercial activities in the region. The UArctic Thematic Network on Arctic Safety and Security addresses the risks of operating in the Arctic and ways to prevent incidents that may represent a threat to human life and health, the environment, values and welfare of the social communities in the Arctic. Cross-border cooperation and optimal use of the preparedness resources of the Arctic countries are highlighted” (UArctic, 2018)

In the Arctic domain, the challenge is to ensure that information is shared with all relevant entities and agencies from the regional or local to international level (Eicken et al. 2016, p. 12). They also addressed the need to implement a test-bed for actors in the Arctic safety domain. States may be losing some of their role in shaping the international agenda and norms. We must prepare for individuals, organisations, businesses, and communities taking a larger role as negotiators on international norms (Ministry of Foreign Affairs, 2018). Co-creation builds trust to share the information and accessibly (Pirinen, 2015), and a more efficient use of resources is made possible by “the digital transformation and advances in artificial intelligence” (Ministry of Foreign Affairs, 2018, p. 11). In light of such challenges in the Arctic contexts, environmental data that is collected in the context of sustained observations of Arctic change play an important role in providing environmental intelligence that contributes to maritime data awareness (Sullivan, 2015). A range of system integration approaches have been identified or scoped out. These include the Alaska Ocean Observing System’s (AOOS) Arctic Data Integration Portal (portal.aos.org/arctic), and

work conducted by the Department of Homeland Security (DHS) Arctic Domain Awareness Center (ADAC). A fundamental challenge is filling the gap of bridging the research to operations. This problem becomes amplified when research infrastructure relied upon for operations and emergency response. This challenge can be circumvented through forming partnerships between the research community and key entities providing information for emergency response, and aided by approaches drawing on technology and infrastructure well integrated into local, national, and international response networks. (Eicken et al 2016). Networks of critical infrastructure often rely on the functionalities of other interrelated networks (Rajamäki & Ruoslahti, 2018), and the roles and engagement of actors, with their mutual interactions become key in networked collaboration, which with situational intelligence is needed to build resilience (Pirinen, 2017). According to Engeström and Kerosuo (2007) networks, with trust that exchange information and resources, and solve problems collaboratively across organizational boundaries, are important in inter-organizational learning.

European Maritime Policy has identified coast guard functions (European Coast Guard Functions Forum, 2014). These European coast guard functions are 1) maritime safety and vessel traffic management, 2) fisheries control, 3) maritime border control, 4) surveillance, 5) security, 6) customs activities, 7) law enforcement, 8) maritime environmental protection and response, 9) accident and disaster response, and 10) search and rescue at sea, and 11) other related activities. International coast guard cooperation is coordinated in networks called coast guard forums. The Arctic Coast Guard Cooperation Network is the newest. Earlier northern forums partially covering or bordering the Arctic are the Northern Atlantic Coast Guard Forum (NACGF), the North Pacific Coast Guard Forum (NPCGF), and the Baltic Sea Region Border Control Cooperation (BSRBCC). They all have a regional maritime focus aiming towards enhancement of information exchange on

maritime safety and security, environmental protection, combat of cross-border crime (PERSEUS, FP-7 Project, 2013). These forum networks represent the various authorities that perform coast guard functions in each country. National systems differ much from country to country. Each ACGF member organisation have specific educational institutions, and research and innovation structures. Present national coast guard authority education systems mostly serve operational targets. They are regulated mostly by professional and organisational purposes, and leave post-graduate, and post-doctoral, levels of education in many cases missing (Ruoslahti & Hyttinen, 2017).

“National authorities use, their own educational resources, and also those of other public and relevant private actors. To fully exploit the potential of an integrated maritime policy, the Coast Guard Functions approach could be extended to the academic and educational sectors” (WMU Workshop, 2014; Ruoslahti & Hyttinen, 2017).

Knowledge sharing and timely information exchange are needed in inter-organizational collaboration, and trust between stakeholders is needed for them to engage with each other (Verghese, 2018). “Despite the various benefits of information sharing for security, even within a limited community of participants, shared information without proper restrictions, however, may leak a significant amount of information about the participants and their operation context” (Mohaisen et al. 2017).

2.4 Resilience of safety and security organisations

Resilience can be defined as a condition describing a system or community's ability to absorb disruption, or attain a desired future (ARAF Chair, 2016). Resilience thinking is an approach to manage, understand, and govern systems (Walker et al. 2012; Folke et al. 2010). According to Vos (2017) resilience can be seen the capacity to adapt and function despite risks and disruptive events and even in turbulent environments. Resilient organisations should take proactive steps, develop new capabilities and expand abilities to create new opportunities (Hamel and Välikangas 2003; Lengnick-Hall and Beck 2005). It has been argued that organisational resilience is related to positive adjustment in the face of challenging conditions through a strengthening of the current and future entity (Sutcliffe & Vogus 2003). In regards to the Arctic, the focus could be moved beyond from assessing the state of science towards evaluation of societal actions to adapt to a changing Arctic; how to cope and build resilience, not only against climate change, but also including other processes, strategic, political and operational (ARAH Chair, 2016). The share of responsibilities by all actors can be seen as the main goal to build processes around and toward overall resilience in the Arctic. A first step is building a common understanding between different perspectives and social, ecological and biophysical ecosystems. (Arctic Council, 2017). From an analytical framework, this paper considers the special focus on social systems and its interactions, but bringing the safety and security organisational resilience into the discussion of Arctic domain.

Innovation networks became a norm rather than an exception (Powell & Grodal 2005) as there has been an increase in the numbers of strategic alliances between the early 1970s to the 1990s (Hagedoorn & Kranenburg, 2003). International co-creation has the potential to provide faster innovations and a common situational picture, risk assessments, and preparation against disaster, including joint capacity building and resource pooling (Ruoslahti & Tikanmäki, 2017; Tikanmäki & Ruoslahti, 2017). Beyond the traditional information sharing among communities of trust

(Mohaisen et al. 2017), collaborative information sharing, situational picture, and innovation open opportunities can support to build resilience in organisations (Rajamäki & Ruoslahti, 2018). Unlike information and data sharing, knowledge sharing is characterised by strong contextuality (Kucharska & Kowalczyk, 2016). What works for one situation may not work for another (Young & Milton, 2011). Cooke & Brown (1999) divide knowledge in either explicit or tacit, and individual or group knowledge, where knowing as action, such as group practices, that “make use of knowledge in new innovative, and more productive ways” (p. 398). Knowledge is identified as explicit when it is visible and expressible. Explicit knowledge is communicated in formal and systematic ways. Tacit knowledge is associated with individual experiences, thinking and feeling and it is more challenging to code, and processed in systematic and logic manner. (Nonaka & Konno, 1998).

Co-creation networks, which aim at knowledge and innovation require active stakeholder participation, and this is best achieved through common aims with benefits for the stakeholders (Rajamäki & Ruoslahti, 2018). Ruoslahti and Hyttinen (2017) argue the need for involving public and private institutions, and, in particular of end users, in creating an enhanced Arctic research and study community. This network for knowledge and innovation should contribute to Arctic safety and security by involving actors in active communication. The Thematic Network community can add communication and new forms of cross-sectorial and cross-regional research and development. Issues that need further focus are common awareness, risk pictures, preparation against disaster, joint capacity building, resource pooling. Knowledge created through sharing experiences and knowledge with reflection (co-created knowledge) is a participatory process in social networks, which use common information sharing environments and trust building through interactions between them (Pirinen, 2015). Co-creation feeds from common objectives. It can occur in either

physical or digital arenas, where collaborators share tools and collaborative processes (Bhalla, 2014). Co-creation and is useful in promoting innovation (Galvagno & Dalli, 2014), and a strategic approach to knowledge management is key to success in networked innovation (Valkokari et. al., 2012). Knowledge can be a source of competitive advantage. It is key to success for modern organisations and for creative higher education (Pirinen, 2015). Dynamic interactions between roles of all levels lead to the creation of new knowledge. This can lead to continuous innovation and a competitive advantage. (Nonaka & Takeuchi 1995). Multi-stakeholder communication can be explained with the issue arenas model for organisational communication (Vos, Schoemaker, & Luoma-aho, 2014; Luoma-aho & Vos, 2010). Shared information and knowledge are needed in innovation networks and co-creation projects. Combining management of projects, networking, and learning can be challenging (Ruoslahti, et. al., 2011). Research shows that co-creation may range between the smallest collaborative innovations in new product development processes to a wider theory of co-creation (Galvagno & Dalli, 2014). Arctic co-creation for safety and security should be active throughout this spectrum. A co-creation network needs common objectives (Ruoslahti, 2017), and it can exist and operate in both or either digital and physical arenas to share cooperation tools, collaborative processes, and contracts between the collaborators (Bhalla, 2014).

Knuuttila (2017) discusses possible difficulties of improving practical resilience through collaboration. It may risk one's autonomy and a possible loss of power. Thus, the division of power between the different actors a starting point to reach targets. Inter-governmental organizations and networks use their political mandate in a top-down manner as macro-level orchestrations. Inter-governmental organizations and networks, on the other hand use micro-level orchestrations. Knuuttila calls for 'hand shakes' between these two levels. Network cooperation can benefit and add value to all sectors that work for a safe secure Arctic domain. Information sharing on the

context of high-velocity environments (Oliver & Roos, 2005) requires collaboration and networks in order to ensure rapid decision-making. The academic interest on information sharing in private and public sector organisations has emerged as major concern (Allen et al. 2014, 419). Participation is still an important channel of knowledge transfer (Pirinen, 2015; Di Cagno, et al., 2014).

Research and Development (R&D) projects benefit future needs of co-creation of knowledge in innovative environments. R&D project activities such as integration between research, work life and higher education supports the perspectives of lifelong learning (Hyttinen, Ruoslahti & Jokela, 2017). Beyond the innovation process knowledge sharing and learning, shared research results, co-created knowledge and information, to study curricula, which may be based on individual and professional preferences, resulting in, for example, a PhD or a multi-disciplinary Master's or Doctorate of Business Administration. Authority officials have broader venues of advancing their individual knowledge and education (Third European Maritime Domain Security Planning Meeting, 2013; Gröndahl, et al., 2014).

Co-creation and sharing require complex mechanisms of communicate and transfer (Saviotti, 1998). Explicit knowledge may be seen as being easier to disseminate and share, while tacit knowledge requires collective social actions (e.g. Halkier et al., 2012). Technology, tools and solutions provide opportunities and for new kinds of interactions to share, collaborate and co-create. Information Communication Technology (ICT) offers opportunities for wider expansion and reach (Siemens, 2005), with a potential to use mix of media (Derry et al., 2006) with different access possibilities (McConnell, 2000). Social media based applications are a way to promote information sharing and promote learning on individual, group, and organisational levels

(Hyttinen, 2017). “Information sharing also has been embraced by various communities, and leaders in such community have created their own sharing exchange points, where participants could deliver and retrieve the shared raw data and annotated data (intelligence) from other participants using standard application program interfaces (APIs)” (Mohaisen et al. 2017). Common Information Sharing Environment (CISE) is one European platform of active participation and open cooperation between authorities on the maritime domain (Ruoslahti & Tikanmäki, 2017). This type of collaboration can be extended to bring together disparate sensor information gathered by authorities also on the Arctic. When different authorities have the capability and the interoperability to when needed help and fill in for each other, continuity of operations become enhanced (Tikanmäki & Ruoslahti, 2017; Ruoslahti & Hyttinen, 2017).

3 Methodology

To build a basis for understanding current networks among safety and security organisations relevant in the Arctic, the main research methods of this study have been participatory observation, expert interviews and reading of materials; this is a work in progress. The research activities of this study model new solutions for a safer more secure Arctic, in collaboration processes, where the researchers have themselves been actors. The data was collected from meeting documents, minutes, notes, and memos, and partly by observing interaction in meetings, events and collaboration workshops that have been held between co-creation network partners (under Chatham House Rule) between 2014 and 2018. The data was analysed by reading the data collection materials and highlighting relevant views and lessons identified that model new solutions to promote safety and security in the Arctic. Thus, the results and conclusions of the study are based on this analysis of collaboration discussions and their documents. Beyond that, the research data is collected from public sources and empirical work is completed during years 2014 – 2018. The data consists of the

conclusions from discussions with policy maker representatives, thematic interviews and the relevant project documents.

Table 1: Overview of data collection methods used

Data collection resources	Method of intervention
Academic article reviews (2014 – 2018) Encounters between multiple stakeholders on Arctic safety and security	In-depth desk study review Active observation and Workshop discussions (n=19)
Use case trials and scenarios developed in European Commission H2020 projects CoopP, EUCISE 2020, MARISA.	Interviews and observations in the end user co-creation communities
Case study materials produced by security management education	Risk management association of Finland risk identification framework was used.

The data was analysed with qualitative methods. The recorded understanding and experiences by the end user community participants were collected in questionnaire forms. This empirical research identified the experiences of current practices. The triangulation of desk study research findings, case study interviews, active observations and discussions have been implemented progressively during several years. The analysis has been done using a data extraction table (DET), where various Arctic collaboration networks are identified and grouped based on the thematic focus, type of partnerships and level of network. As a final results of the analysis, a comprehensive approach for collaboration to build resilience in organisations was described. The findings are discussed in more detail in the next section Results.

4 Results

The results section of this paper discusses the collaboration practices and experiences in building resilience of operations on the Arctic. The sub-sections look at safety and security networks in the Arctic, and the role of information sharing in building resilience of safety and security

organisations. Also, cross-sectoral and cross-level information sharing cooperation for knowledge and innovation in Safety and Security organisations are discussed in this section.

4.1 Safety and security networks in the Arctic

Information and knowledge sharing, as well as cooperation of safety and security organisations was seen by the respondents as crucial in the Arctic context. The hazardous Arctic context requires new type of actions among security providers. Cooperation entities can be seen as new forms of organisations in the safety and security field because of the nature of work in Arctic. Some current safety and security cooperation entities with thematic their focus and partners are categorised below in Table 2.

Table 2: Examples of collaboration networks for resilience on the Arctic

Cooperation entity	Thematic Focus	Partners	Network level
Arctic Council	Agreement on Cooperation in Aeronautical and Maritime Search and Rescue in the Arctic	Arctic states and organizations of indigenous people	Policy maker
The Arctic Council's Emergency Prevention, Preparedness and Response Working Group (EPPR WG)	Enhance the capacity for pan-Arctic emergency response by coordinating national efforts	Arctic states and stakeholders	Policy maker
IMO	Maritime safety; Guidelines for Ships Operating in Polar Waters (IMO, 2010)	Global maritime states	Policy maker
The Barents Euro-Arctic Council (BEAC)	Forum for intergovernmental cooperation on issues concerning the Barents region.	States of the Barents region	Policy maker
University of the Arctic (UArctic)	Arctic Safety and Security (Thematic Network)	Universities interested in Arctic issues	Academic
International Arctic Science Committee (IASC)	Guidelines for international science policy and research cooperation on the Arctic	Universities interested in Arctic issues	Academic
Association of Polar Early Career Scientists (APECS)	Cooperation between students and researchers in the early phase of their careers	Scientists interested in polar studies	Academic
Coast Guard Forums: – Arctic (ACGF) – Northern Atlantic (NACGF) – North Pacific (NPCGF)	Enhance the capacity for pan-Arctic emergency response by coordinating national efforts	Authorities that perform coast guard functions	Authority

– Baltic Sea Basin (BSBCGF)			
Baltic Sea Region Border Control Cooperation (BSRBCC)	Regional maritime focus and enhancement of information exchange on maritime safety and security, environmental protection, combat of cross-border crime	Authorities that perform coast guard functions	Authority
The Barents Rescue exercise series	To strengthen the resources of countries in the Barents Region, an area of vast distances limited resources	Authorities and supporting stakeholders responsible for preparedness and response to emergencies in the Barents Region	Authority
World Ocean Council (WCO)	Global, cross-sectoral ocean industry leadership alliance committed to “Corporate Ocean Responsibility”, with multi-sectoral approach	Ocean industries (shipping, oil and gas, fisheries, aquaculture, tourism, energy (wind, wave, tidal), ports, dredging, cables, maritime legal, financial and insurance communities	Practitioner
KRIVAT	Faster recovery from continuity threatening event or crisis	Industries responsible for critical infrastructure	Practitioner

As seen in Table 2, the University of the Arctic (UArctic) is one important network for academic collaboration. It supplements coordinative bodies, such as the International Arctic Science Committee (IASC) that provides guidelines for international science policy and research cooperation on the Arctic, and the Association of Polar Early Career Scientists (APECS), which promotes cooperation between students and researchers in the early phase of their careers. The UArctic is a collaboration network for universities, colleges, and other organisations that are committed to higher education and research in the North. The network has close to 150 institutions that enhance research, student exchange, and training between participating universities. Members “share resources, facilities, and expertise to build post-secondary education programs that are relevant and accessible to northern students” (University of the Arctic, 2013). For focus, the UArctic has Thematic Networks. Arctic safety and security touches the focus of many Thematic

Networks, and there is now one that focuses specifically on it: The Thematic Network community can add value to the sectors that aim towards a safe secure Arctic domain. As the role of higher education is changing, there is need for new methods. National coast guard functions authorities' educational institutions form bodies of knowledge through interaction with practitioners on their respective fields. "Professional best practices are transferred from generation to generation both inside and outside of existing formal curricula. A coordinated, genuinely open and coast guard functions focused post graduate study environment for authority officers is now missing" (Ruoslahti & Hyttinen, 2017). Active coast guard personnel serving in their authority organisations may not be willing to freely, in an open academic manner, address and discuss professional problems and lacking solutions. Traditionally retired officers are more active in expressing their views (Third European Maritime Domain Security Planning Meeting, 2013). The thematic network on Arctic Safety and Security, under the University of the Arctic (UArctic) framework, is coordinated by Nord University (University of the Arctic, 2018). This network of co-creation aims to promote safety and security on the Arctic domain by adding communication and new forms of cooperation through cross-sectorial and regional research and development. The Arctic Council's Emergency Prevention, Preparedness and Response Working Group (EPPR WG) and the Arctic Coast Guard Forum are examples of key entities to enhance the capacity for emergency response by coordinating national efforts at the pan-Arctic level (Eicken et al., 2017).

4.2 The role of information and knowledge sharing in building resilience of safety and security organisations

Thus, the discussion on the safe use of Arctic resources is very contemporary. This paper argues that there is a need to develop information sharing and collaboration across the levels, 1) policy, 2)

higher education, 3) authority, and 4) individual practitioner networks on the Arctic, to promote and ensure safety and security in the Arctic domain. Part of the safety and secure approach organisational resilience should be based on innovation processes with understanding of co-creation and learning. Multilateral strategies have been argued to ensure stable and harmonized priorities (Haftendorn, 2016). Collaboration agreements, such as the *Agreement on Cooperation in Aeronautical and Maritime Search and Rescue in the Arctic* (Arctic Council, 2011) and the *Guidelines for Ships Operating in Polar Waters* (IMO, 2010) are needed to guide further development towards a more proactive safety and security throughout different levels of collaboration, from policy making, through academic research and higher education, and coordinated coast guard functions, to the level of individual operators of oil rig, vessel, or aircraft and inhabitants of the Arctic. The State Security Networks Group Finland KRIVAT service of is one example of an information sharing and cooperation framework in the Arctic. It is explicitly designed to manage disturbances by collaboration between practitioners to secure continuity of operations in case of harsh Arctic winter storms, for example (Rajamäki & Ruoslahti, 2018).

The increasing threats raise the need for multiscale resilience among security organisations in the Arctic domain. Good practices and failures of incidents should be better informed and information shared in collaboration and cooperation. The emergency planning processes and other civil protection and safety related processes should be better planned among organisations. The preparedness resilience architecture in collaboration networks can be strengthened through re-defined threats and potential emergencies, identified roles and responsibilities of all relevant safety and security organisations, and developing the global and national strategies in line with operational actions. The findings elaborates that better sharing of information and knowledge should lead to better situational awareness and decision-making. These benefit all Arctic seafarers

and other actors. Co-creative approaches involve several actors from different collaboration network layers and include outside experts, who create shared commitment. This kind of co-creation approach facilitates reaching shared goals (Hyttinen, Ruoslahti & Jokela, 2017). Respondents and workshop results indicated that co-creative innovation process part of resilience among safety and security is still rather low level. Security and safety actors mainly share knowledge and information based on lessons identified and to build strategic and political cooperation. Also cross-sectoral or cross-level cooperation mainly takes place between one or two sectors, such as operational and policy.

4.3 Cross-sectoral and cross-level cooperation for co-creative innovation in Safety and Security organisations

The co-created arctic network community can focus on safety and security related academic basic research and educational networks. The ACGF network has an opportunity, through co-creation to promote more unified requirements to educational coast guard and other public actor institutions on the maritime domain. Integration may apply new methods and strategies to enhance collaborative activities (Hyttinen, Ruoslahti & Jokela, 2017). The study found out the current collaboration co-creative practices as follows:

- 1) The UArctic Thematic Network can provide, for ACGF, an arena for open study and co-creation of common mechanisms to complement existing forms of cooperation on to coast guard functions related issues, supplementing the existing collaboration within the European Coast Guard Academies Network Project initiative (Third ECGFF Secretariat Meeting, 2013). “The co-created arctic network community can broaden the focus of

today's defined training oriented National Coast Guard Institution educational programs” (Ruoslahti & Hyttinen, 2017).

- 2) Active cooperation can provide the UArctic Thematic Network members with opportunities for R&D related co-creation, innovation processes and learning. Thus, the role of higher education institutions face new opportunities that stem from this increased networked expertise (Pirinen, 2015). Projects can be useful for knowledge creation with use of multiple resources and including students in to the process. Students have the opportunity to access expert communities. “Integrating project tasks with studies serves both project and curriculum goals very well” (Hyttinen, Ruoslahti & Jokela, 2017).

Value can come from a multi-disciplinary and multi-level platform of cooperation and study for individuals and researchers interested in security and safety and activities in the Arctic. ICT tools and opportunities can enhance information exchange and participation possibilities for knowledge creation and finally to innovation management. It can demonstrate new knowledge on future cooperation (e.g. in SAR) and to change current mind-sets toward cooperation and sharing of information to benefit the security and safety in the Arctic (Ruoslahti & Hyttinen, 2017).

As a final result, the analysis of this study described a comprehensive bottom-up-top-down approach to better collaborate among actors between and across different network layers. It was recognised that collaboration and knowledge sharing mainly happens only within collaboration levels relevant for the actor and enhanced collaboration mainly focuses on maximum of two sectors or two levels. The future needs and threats in the Arctic require collaboration across all sectors,

levels and layers with use of co-creation methods to ensure innovation creation and implementation, also among safety and security actors, as is seen in Figure 1 below.



Figure 1: A comprehensive bottom-up-top-down approach to collaboration between safety and security networks in the Arctic

5 Conclusions

Creating a new long-term co-operation among the various levels of Arctic experts can be achieved by bringing together these different levels of collaboration and co-creation networks, political, academic, and governmental and practitioner. A comprehensive understanding for new knowledge and effective cooperation may bring positive change in current mind-sets to provide further innovations and to tackle complex threats and challenges better. It is best, when end users are involved in this co-creation process. This input of end users can promote collaborative problem solving with production of innovations. This kind of development is instrumental in building organisational resilience for increased safety and security in the Arctic. Multi-disciplinary and

multi-institutional Arctic network community collaboration has the potential to build resilience through innovations. They also bring now disparate security, safety and risk management, and communication practitioners together with not only with one another but also with relevant end-users, researchers, and other stakeholders. The respondents and various actors that have been subjects in this study promote interaction systems in sharing of knowledge and information among actors and support the learning from resilience view point. Knowledge can become co-created, through open information sharing between network members and experts who trust each other.

Education programs in this context provide improved learning possibilities, which free from time or place. Flexible approaches enable students across the network to choose learning curricula content best suited to individual interest. This paper suggests that the Arctic Thematic Network community should also award higher levels of post post-graduate and post-doctoral education. The educational profession is changing and professionals need a varied set of skills to manage network-based co-creative integration.

Social media and open source tools require further pilots and study among international security professionals and other communities of interest in the Arctic domain. Cross-sectoral and cross-level Communities of Practice (CoPs) may produce explicit and implicit knowledge and further they should develop paths to develop and co-create new solutions, products and innovations. The UArctic Thematic Network is one opportunity, already in motion, of bridging between the much defined scopes of the many institutions that focus on coast guard functions, security, and the clearly broader higher education focus of the entire UArctic collaboration network. The focus of today's narrowly defined training oriented national coast guard institution educational programs can be broadened. Broadly defined academic basic research networks (UArctice Thematic Network) and

authority communities (ACGF and European Coast Guard Academies Network Project) bring end users to network with academics and policy makers (e.g. Arctic Council). This should provide opportunities for multi-disciplinary approaches toward secure and safe activities in the Arctic.

Enhanced Arctic research and developments contribute to a cleaner, safer and more secure Arctic domain. Insights for sustainable economic growth, international processes and best practices become developed. Better situational awareness and decision making benefit everyone operating in the Arctic. Further work should focus on co-creation processes and knowledge exchange first within, and second between the UArctic Thematic Network and relevant end user networks (e.g. ACGF) to identify ideal modes of cooperation. In complex and challenging safety and security environment require trust building multi-sector and multi-level collaboration to share explicit and tacit knowledge towards future solutions. International Arctic multisector policy, academic and educational networks and authority collaboration structures (e.g. ACGF), and ship-level safety and preparedness measures and cooperation should form a uniform continuum for the safety and security of the Arctic.

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