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Abstracts from the panel

Exploring Future Work Practices for  
Information Sharing and Achieving Common  
Situational Understanding in Disasters



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# New perspectives for emergency response – Lessons learned on crisis mapping from trials and exercises

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In support of crisis management new technologies are continuously being developed. The remaining challenge for practitioner organizations is not only to identify suitable solutions to close their gaps, but also to test and evaluate its benefit before the disaster strikes. The EU-funded project DRIVER+ (Driving Innovation in Crisis Management for European Resilience) has therefore designed a methodical and technical environment to assess innovation in crisis management in a realistic but non-operational setup through trials.

To bridge theoretical potential and practical implementation, the Center for Satellite Based Crisis Information (ZKI) at the German Aerospace Center (DLR) has been working closely with its users for years to apply new methods from remote sensing research to generate up-to-date situation information for civil security applications and disaster response products. In DRIVER+, ZKI interdisciplinary teamed up with colleagues at DLR to demonstrate near real-time contextual routing for crisis response. Experienced practitioners assessed its added value during a trial focusing on major urban flooding events. Systematically collected data through the DRIVER+ Test-bed approved that DLR's system could improve transport planning and inter-agency situational awareness. Together with the Bavarian Red Cross, ZKI further tested the application of 3D situational awareness in an earthquake scenario during the EU civil protection exercise IRONORE2019. We will present the results of the two exercises and how user feedback is driving the further development of ZKI products. In addition, we will discuss how new developments as 3D mapping, AI and web data fusion will provide further opportunities for remote sensing in future to support emergency responders even more effectively in complex crisis scenarios.

# Your COP? - I see it differently. - Sharing experience of working with practitioners on COP.

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Moving from the theoretical concept of COP to the domain of practitioners and the relevance of 'the' COP versus one of multiple COP's are vital components of a discussion where the technical feasibility and implementation are of secondary importance.

Our contribution consists in sharing some experiences from preparedness projects, exercises, the realisation of a national C2 (Command & Control) system and real crisis situations in various countries and cultures, emergency services and levels.

Whereas Common Information is crucial in concerted or even joint decision making, an important observation in our work is that culture, training, organisational background, personal experience, psychological characteristics, type of crisis and focus of decision making hinder the generation of just one COP that would provide equal insights to all involved decision makers and emergency responders.

The question is then, do we harmonise the human actor or do we customise the COP and if the latter path is envisioned, do we have the knowledge and technology to do so.

The panel contribution would consist of an overview of observations and assessments confirming or challenging some of the aspects of the COP literature, ranging from object visualisation to data sets required for decision making at the operational, tactical and strategic level.

A fairly unique component of that will be the observations from the ICMS project, where over a period of more than a year, workshops were organised with stakeholders from all relevant emergency responding actors in Belgium as a phase in the creation of a national civilian C2 system.

This contribution is also related to the presenter's doctoral research where the interaction between person, team, information, process and environment as complementary components of emergency management are addressed.

# Balancing levels of operational support of map-based tools for facilitating a common operational picture

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Map-based tools facilitate a common operational picture (COP) for emergency management. Since there is no univocal definition of the COP, its map-based tools differ in terms of offered functionality. While some tools provide a map equipped with basic interactive functions, others offer rich functionality built in a map display assisted with auxiliary visual components such as a timeline or a reporting panel. Different levels of functionality are caused by diverse requirements regarding operational tasks supported by COP tools. If a given COP tool supports emergency scenarios relevant for one emergency responder, required functionality can be planned through the tool's co-design engaging representatives of that responder. However, if a COP tool is to be used by several emergency responders, then, required functionalities need to be negotiated between potential users. Such negotiations are necessary to determine a balance between a general level of essential functionality included in COP tools for emergency management and specific interactive functions wished by some responders, but likely to generate confusion to other responders.

This paper reports on our research on the level of operational support of COP map-based tools for Norwegian emergency responders. We pose two research questions: What are the requirements for operational support of map-based COP tools expressed by various emergency responders in Norway? What are the interactive functions of COP tools desired by emergency responders during their operations? While the first question considers specific emergency scenarios in which COP tools are used, the second aims at revealing a list of interactive functions to be of primary importance to the emergency responders. To gain empirical material, we undertook several steps. First, we surveyed COP map-based interfaces in use by selected emergency responders in Norway to gain a comprehensive insight into their functionality (i.e., supported use case scenarios). Next, we interviewed representatives of six emergency responders. Lastly, we organized a desktop exercise where we used one of the well-known COP tools to elicit shortcomings and to highlight functionalities essential for supporting future emergency work practices related to COP and situational awareness. Based on our findings, we propose the concept of a “web repository” containing the list of essential interactive functions to be included in a “common operational functionality.” Furthermore, we implement the concept of the repository in a prototype of a web tool that exemplifies essential interactive functions and provides them to developers in an informative and attractive manner.

# MAPS AND MAPPING PRACTICES IN SEARCH AND RESCUE OPERATIONS IN NORTHERN NORWAY

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Unpredictable weather, scarcely populated areas and long distances can be strenuous for Search and Rescue (SAR) responders in Northern Norway. Because operations are time and location sensitive, responders are heavily relying on maps— from planning out resources for response to navigation and information communication. Despite of being indispensable, maps and mapping processes are overlooked in research regarding SAR. With this presentation I seek to explore complex networks of maps and mapping practices that take place during SAR missions, with special focus on information communication.

My research is situated in Posthuman tradition, more precisely – New Materialism. It emphasises entanglements as a constitutive force, challenges dichotomic worldview and extends agency to more-than-human actors. Consequently, my point of departure is to analyse maps as interacting actors and as networks *per se*, where heterogenous interactions take place. In this manner performativity and representation of maps are processual outcomes of interactions, not pre-given features.

Focusing on maps as networks allows me to expand the research from immediate surroundings to processes which happen on different spatio-temporalities. This takes me through various “construction sites”: I conduct interviews with people working on rescue boats, helicopters, coordination centre, as responders on land, or with map modelling, and analyse documents related to mapping and SAR, such as international manuals, regulations, incident or exercise reports.

Preliminary findings show that maps deployed in SAR missions are everything but unified, ranging from paper maps to GPS tracking devices. The responders in the field could be using several mapping platforms at a time, differentiating between maps due to their technical capabilities. Different practices of employing maps are intertwined with the need for information flow and external conditions.

Digital maps require complex networks containing different data sets and data acquiring tools. Within these networks data communication and translation happens on various levels and includes strings of interactions between matter, international and national regulations, radars, waves, signs and symbols.

New Materialism might not have a clear cut answer of how to improve future work practices of emergency responders. However, this perspective can contribute in shaping them by exploring multiple layers of information communication and translation taking place when maps are employed within SAR operations. Unravelling the “black box” of maps and their complex interactions provides a possibility to see where and when practices can have unexpected outcomes.

# Adoption and use of standard operating procedures for emergency response

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Standard operating procedures (SOPs) are important as a basis for effective emergency response. These procedures specify roles, tasks, and steps to be taken during different stages of an incident. The different first responder agencies and other organisations involved in emergency response have SOPs specifying their operations and communication protocols, both for internal operations and for joint operations involving collaboration between several organisations. These procedures exist in different forms and formats, involving varying degrees of computer support.

While the SOPs are part of the training of first responders, experience from real events as well as exercises show that the use of the SOPs are often varying and somewhat inconsistent even within the same organisation. The procedures are also typically underspecified regarding from where relevant information should be collected, how this information can be accessed, and whether this information should be shared with other responders. Also, first responders argue that the format of the SOPs often is not perceived as effective for supporting their operations in time critical situations, in terms of level of detail, accessibility and presentation clarity. Experienced emergency dispatchers in command and control centres report how following rigid communication procedures sometimes is considered to be non-conducive for an efficient dialogue with the caller. Also, procedures for efficient combination of various data sources to gain optimal value from these while also avoiding information overload, are also often missing in these command and control centres.

The presentation is based on findings from the INSITU project funded by the Research Council of Norway, investigating current practices for information sharing among organisations involved in emergency preparedness and response in Norway. From workshops, interviews and observation in exercises, we analyse existing use of SOPs and possible improvements of these. In a recent digital tabletop exercise using a multiple forest fire scenario, we collected data on how situational reports and common operational pictures were shared from the local incident command and fire services to the affected municipalities and county, to providers of critical infrastructure (energy grid, telecommunications, road administration), and to the national level of emergency management. The findings show how efficient SOPs for situational reports and information sharing are either missing or have limitations negatively affecting the support from these procedures.

We will discuss factors influencing the adoption and use of SOPs among emergency stakeholders, and present recommendations for developing and implementing procedures that can effectively support emergency operations through consistent and widespread use.

# Harmonization of Terminology for Emergency Management

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The lack of a common terminologies and map interfaces, as well as different information needs among different first responds groups are hindering effective information sharing in disaster situations to get a common operational picture (COP).

An ongoing national research project aims to contribute to common situational understanding between actors in disaster situations by addressing these issues, in particular through harmonization of terminologies, to facilitate efficient communication and avoid misunderstandings between different emergency management actors and organizations. One of the project partners is developing an app and a web browser extension that can be used for looking up different definitions of terms from relevant standards and reference documents. In particular, "The Rescue Handbook" published by Norwegian Rescue Services is used as a test-document, allowing users to look up any word in the handbook and where particularly relevant words are underlined to indicate that you will be able to find a definition.

In spring 2021, the software has been tested in a series of workshops with relevant stakeholders, for eliciting comments, suggestions for improvement, and opinions about the usefulness in emergency management where actors from different rescue organizations have to work together. The preliminary results are very positive, and the participants have evaluated the software as "useful" (57%) or "very useful" (24%) after trying it, compared to their expectations before trying it: "useful" (52%) and "very useful" (14%), illustrating that it has exceeded their expectations. The definitions provided by the software were also found to be mostly well aligned with their own understanding of the terms (52% yes, 43% partly). It was noted that some organizations had firewalls blocking the software, thereby hindering the participants in testing it on their work devices. The functionality still worked fine on their mobile devices for those who tested. The software does not work with Internet Explorer. This browser will be phased out by 2022.

The availability of common or contrasting definitions of core terms from different emergency organizations can then be used as a starting point for harmonization of the terminologies among them. The harmonised result can then be used to update the terminology included in Redningshåndboka. We expect this results to be used for larger events with rescue organizations from neighboring countries handling a cross-border disaster on land or on the sea.

The main contributions of this work is to enable users to look up definitions directly from texts and for harmonisation of glossaries we provide a search across relevant glossaries and ways to compare glossaries automatically to highlight similarities and differences. Overall this can contribute to a common terminology and clear unambiguous communication and information exchange between different actors and organizations in a disaster situation.

# Using quantitative data effectively to manage crises

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Many companies use quantitative business intelligence (BI) technologies to collect, process and analyse data, which provides valuable information that can be used in the decision making process. The extent to which an organization can use all available data effectively plays an important role in how successful an organization is. BI can be useful for commercial purposes, but can also be applied in the public sector (Olszak, 2016).

Within the domain of crisis management, however, little attention has been paid to the subject of designing quantitative business intelligence processes successfully to manage crises. Literature on crisis and disaster management tends to focus on how information can be qualitatively processed. In order to successfully use available information in the decision-making process, these theories tend to focus on the concepts of sense-making and meaning-making (Klein et al., 2010). The available research considering data management within the crises domain, e.g. research examining early warning systems, seems to overlook the useful principles that existing literature provides (Poslad et al., 2015).

The relevance of effectively combining business intelligence processes with existing procedures in crisis management processes was demonstrated during the COVID-19 crisis. In light of this crisis, organizations were challenged with the task of designing quantitative supporting structures (Janssen & Van der Voort, 2020). But how do we connect the 'quantitative domain' and the 'qualitative domain' adequately?

We argue that crisis management literature lacks an overall theory of how the gathering, processing and analysis of quantitative data can be unified with the qualitative processes of sense-making, meaning-making and decision-making. Therefore, we developed an initial model that includes and connects both worlds.

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# Dosed access to the common operational picture

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We view modern communities as webs of interdependent institutions, social networks, physical entities and critical infrastructures. A crisis boils down to a failure that ripples through the fabric of the community and threatens or impacts vital community interests. Given their wicked nature (Head, 2008), crises can best be responded to by a networked organisational collective (Kapucu, Arslan, & Collins, 2010) in which all relevant expertise is involved.

A common operational picture (COP) is generally seen as a valuable contribution to a networked response (Treurniet & Wolbers, 2021). The organisations in the network maintain and share their own picture of the crisis as part of the COP, and in so doing they continually and iteratively frame, elaborate, question and reframe the situation (Klein, Wiggins, & Dominguez, 2010).

The word 'common' in COP suggests that all information in it should be shared with all organisations that might need to be involved in the response (Treurniet, Boersma, & Groenewegen, 2019). We propose an information sharing strategy that strikes a balance between unlimited sharing of all information available and letting each individual organisation decide on what information to share with whom. The access to information is organised in a cascaded way. The location, nature and extent of the crisis is pro-actively shared with all organisations for which it might be relevant, in order to let each organisation assess whether or not the crisis affects its area of responsibility. The information valve can be opened and closed in a number of predefined levels as needed. In so doing, each organisation has a substantial role in deciding on the nature and extent of its role in the response to the crisis, while the shaping of the crisis response network is still done in a controlled way.

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# Future Full-Scale Digital Exercise for Emergency Management

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Due to Covid-19, physical emergency management exercise is challenging, especially if it is designed as a full-scale exercise which often resource-intensive, conducted in real time, try to mimic the real incidents, and often as demanding as in a real incident. In such exercise, information sharing and collaboration to reach the common operational picture (COP) is often particularly essential element of the of the exercise. Various technology supports would be deployed, such as emergency communication devices, and emergency management information systems (EMIS). Another alternative model is a Table-top exercise that is simpler, where a leader will lead the session with some scenarios and supply lead questions that trigger the need to assess the situations and decision options, including the consequences of each choice. Table-top exercise is also typically done face-to-face, with fewer participants. The adoption of the physical table-top exercise to be the digital one would be more straight forward, but not for a larger scale of exercise that engaging multi-stakeholder participants.

This article proposes an alternative design for full-scale but table-top in nature, presenting as digital exercise that ensures information sharing, collaboration and achieving Common-Operational-Picture, process, and challenges. The research questions are: 1) how to design a digital exercise that could replace physical full-scale exercise? 2) What processes need to be done to fulfill the satisfying digital exercise model? 3) What factors enable and hinder the successful implementation of digital exercise? This work is a case study, based on a research project incorporating a full-scale exercise in a digital manner, involving 80 participants from 20 organizations. They represent fire services, police, county's crisis manager, municipalities, GIS experts in national and local levels, road authority, critical infrastructure operator. The complexity of the arrangement rather lies in the effort a balance exercise that would engage all involved organizations. The exercise planning were fully collaborative participatory-design processes between researchers, especially the county's crisis manager and chiefs of fire services (between January to March 2021).

One of prerequisites for successful digital exercise was the high degree of engagement and trust among the researchers and practitioner to produce high-quality, satisfactory exercise model. As such digital exercise is a completely new for involved organizations, a pre-exercise preparation for a training for all, were done prior to the real exercise and it seems contribute to the successful implementation, and thus should be considered into the design.

# SCATTER (Strategische Patientenverlegung - Strategical transfer of patients) A computer-based simulation of inter-hospital transfer of critically ill patients

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During the COVID-19 pandemic an increased need of ICU (Intensive Care Unit) capacity at regional level was seen in many countries, including Germany. To ensure adequate medical care, referrals of critically ill patients were necessary, partially long distance. New organisational structures were implemented to allocate patients from highly to less affected regions (1).

Transporting critically ill patients is associated with risk of adverse events (2). Well-equipped vehicles and highly educated personnel are needed to reduce the risk for the patient and ensure continuous medical treatment throughout the transfer (3).

To date a nationwide transportation strategy for critically ill patients does not exist in Germany.

The object of SCATTER is to develop a computer-based simulation for strategic long-distance referrals of critically ill COVID-19 patients and to obtain recommendations for future referral requests. The simulation model uses Geographic Information Systems and combines discrete event and agent-based modelling.

To build a realistic simulation, a wide range of data has to be considered: location of hospitals, their level of patient care, ICU capacities, means of transportation, patient characteristics and their impact on transport duration and hand-over time in the sending and receiving hospitals. The data will be based on protocols and timestamps from past COVID-19 transports.

The simulation model is in the latter stages of development having implemented the core process logic, like information about intensive care transport resources and their behaviour, as well as available system data. Validation is done through exchange with process experts discussing the implemented logic and necessary assumptions for parameters. The simulation has already been used successfully to examine a set of test instances. The current focus is on choosing a suitable experiment design to extensively study tactics for strategic long-distance referrals.

This simulation can also be used for other scenarios such as loss of infrastructure, terror attacks, natural disasters etc. A broadening to international referrals of patients could also be of interest.

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