THE POTENTIAL OF MULTIPLE TYPES OF SENSOR DATA AND INFORMATION EXCHANGE

CHALLENGES, NEEDS, PERSPECTIVES FOR AN OPERATIONAL PICTURE FOR THE RESPONSE TO CRISES WITH MASS INVOLVEMENT

Karin Rainer, Georg Neubauer, Veronika Ruzsanyi

Keywords

Inclusion of multiple sensor data, effects of holistic data use, crisis management, mass involvement, enhancement of the operational picture in response phases, ethical and societal challenges, information exchange, interoperability

Abstract

Taking the experience of the recent past and anticipating future developments into consideration, crises with mass involvement require the development and inclusion of holistic data sources to gain the necessary, full-scale operational pictures for an efficient, timely, and sustainable response by the teams in the field and on strategic levels. Migration movements, but also challenges of planned or un-predicted mass gatherings and their potential escalation have been identified by experts and responsible organizations as scenarios in need for more detailed and stratified data than just quantitative counts and flow analyses. Learning from past developments and practice examples it becomes clear, that additional, multiple types of sensor data can and should be used to complete and further diversify the operational picture necessary for the targeted and qualified crisis management delivered by response units and public bodies. In addition to this, the early preparation of further care and support of potential casualties or refuge seeking persons can be facilitated due to the detailed and enhanced data. Special needs, targeted assistance in emergencies, but also security related issues like the separation of rivaling groups can easier be facilitated due to an expansion to multiple types of sensors and data adding up to the commonly used visual sources like audio data by including sources like chemical sensing, digital meta data or enhanced pattern detection and processing. In addition to data and information extracted from data, optimized exchange of messages between stakeholders is the second pillar for an improved operational picture.

1. Different Sources of Sensor Data in Crises with Mass Involvement

In current dynamic crises with mass involvement, for which the migration movement of the last years can be seen as a representation, a solid but also restricted set of data sources is used by some organizations to support and facilitate a rudimentary operational picture. Mostly visual, in

exceptional cases also audio channels and movement patterns or acceleration data are included to enhance the overview in the response phase.

Partially well-established practice approaches include the use of large scale satellite data as well as of visual data provided by different types of cameras and optical sensor devices offering e.g. different spectra of visualization and their specific use for an enhanced overview of a critical or escalating event. Supporting the common intelligence by eye witnesses – conveyed either by traditionally qualified in-house sources generated in field missions etc. or by digitally facilitated sources like citizen sensing or crowdsourcing – this type of data can overcome obstacles like remote and inaccessible areas, hostile climate or weather conditions, unclear situations, or additional hindrances for common visual contact.

Examples like the inclusion of additive data and data sources/sensors for the support of the creation of an enhanced operational picture can be found in security research projects (mig.data, WatchDog, EBeCa) but also in several good practice examples of everyday use in singular security and response organizations.

2. Interoperability – Enhancing the operational picture by sharing information

A predominant requirement in multiple domains of crisis and disaster management as well as other security domains such as management of migration movements is an improved operational picture. Nowadays collaboration between stakeholders such as authorities, first responders or military services is predominantly based on face-to-face meetings, email messages, telephone calls, paper charts, fax messages and in several cases proprietary electronic systems. The typical process of information sharing is often limited and a common operational picture is hampered by the fact that they involved stakeholders have potentially complementary pieces of information available, but only take partially advantage from the option of sharing their information and thereby enhancing their operational picture. It has been shown by systematic analysis of the management of about 50 past European disasters that 34% of stakeholders' requirements for improved disaster management are related to improved interoperability. This was by far the most frequently type of expressed request, followed by request for technical solutions and resources, 15% each.

Several challenges have to be faced to reach optimized information exchange. Aside linguistic barriers, the lack of common taxonomies is often impeding optimized exchange of information. Stakeholders insist on using their own IT tools due to practicability reasons as well as prevention of disruption of their procedures and processes. In practical terms this means, that they are not ready to use additional tools specifically designed to exchange information. A new information sharing approach that arose from this situation is the paradigm of a common information space (CIS).

A common information space allows information exchange of different IT tools of entities in an automated way and enables stakeholders to continue to use their own tools with their specific user interfaces. In order to make this "seamless" information exchange possible, an adaptor to the CIS needs to be developed for each of the IT tools connected to the CIS. Beyond the challenge to exchange information between different IT tools, there is need to ensure mutual understanding of messages. Understanding is often hampered by the fact that organizations often have different concepts with proprietary terms leading to limitations in understanding. This stresses the request for solutions for semantic interoperability in order to map concepts from different taxonomies.

3. Gaps and Needs – Perspectives not (yet) provided in current Crisis Response

Due to the evident and also well documented current situation expressed by response organizations and their leading staff, a need for an enhanced operational picture for sensing early signs or even prediction of movement of masses was expressed. This reactive type of sensing of potentially critical masses and their flows can only contribute to a very rough and undifferentiated picture of the involved persons, their socio-cultural constellation and thus their specific vulnerabilities and needs to be covered. Provisions and preventive measures e.g. prone to minimize certain dangers or risks and that can result in a timely and more precise, granular picture could contribute to a sustainable management of scenarios that were overwhelming or at least not sufficiently oriented on the dynamic and dynamically changing requirements of the moving masses.

The integration of a broader set of relevant data – and thus of novel or not sufficiently included sources and sensor types – represents a relevant option of implementing a bigger, selectively used pool of reliable jigsaw pieces to constitute a holistic knowledge of the scenario. Having derived an improved operational picture from multiple types of data sets, the impact can be improved in addition by sharing selected information with other stakeholders involved in the management of moving masses. Such collaborations have very high potential at border crossing levels.

4. Initiatives and approaches to include multiple Sensor Sources

Project WatchDog and proposals under evaluation like mig.data show the importance of the inclusion of multiple different sensor sources to provide novel perspectives. These recently not to the full benefit of the operational picture used initiatives show ways, how to include data received from sources like chemical sensing, additional visual and spectral sensors, satellite technology as well as pattern and movement analyses to enhance a holistic picture that is no more reactive but pro-active and taking into account specific needs and inherent structures of the moving groups.

This situation led to multiple research initiatives both on national as well as international level. For instance, demonstrators of such a CIS were developed in several European research projects. The focus of these CISs' differed considerably. For instance, in the frame of the FP7 project EPISECC the developed CIS allows message exchange of stakeholders with specific focus on the response phase. Key terms of the messages can be semantically enriched in this case. In contrast, the CIS developed by the FP7 project team supports information sharing and retrieval for preparation activities. Other projects were focusing on adaptation of communication technologies (Redirnet) or integration of different types of legacy systems (SECTOR). The Austrian national project INKA allows exchange of information between civil and military command and control systems. Improved information sharing is a predominant requirement relevant for multiple areas of crisis management, including management of mass movements. The type of information encompasses messages as well as sensor data and information extracted from multiple type of sensors.

5. Challenges and open issues conclusions on the legal, ethical, societal and technical side

However, these new types of sensors and data to be included to a pool of selectively used data raise also questions and requirements on the legal, ethical, and societal side adding up to the technological challenges to be handled. Questions regarding data protection, human rights, gender and diversity aspects have to be weighed and in-depth surveyed in dependence with the potential benefit of an enhanced security and safety of moving groups.