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

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Abstract

Taking into account the experience of the recent past and anticipating future developments, crises with mass involvement require the availability of holistic data sources. Such data have to be integrated into the crisis management procedures 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 data, 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 taken into account and integrated. This is a growing requirement to complement, further diversify and structure the operational picture 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 people can be facilitated by more detailed and enhanced sets of data. Thus, special needs, targeted assistance in emergencies, but also security related issues like the separation of rivaling groups can be facilitated. Due to the inclusion of multiple types of sensors like audio data, chemical sensing, digital meta-data or enhanced pattern detection and processing adding up to commonly used visual sources, the tackling of blind spots and weaknesses in current crisis management can be supported. Besides the inclusion of data and information extracted from multiple sensors, an optimized exchange of targeted information between stakeholders was identified as the second pillar for improving the operational picture.

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

In current dynamic crises with mass involvement (as described by Özdamar (2015)), for which the migration movement of the last years reaching Europe 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 rough operational picture. In most cases visual/optical, sometimes also audio channels and derivations of movement patterns or acceleration data are included. To a certain degree and taking into account the question of the timeliness of data, they enhance the overview in the response phase, but also support simple predictive patterns and models for limited early warning systems.
Partially well-established practice approaches include the use of large-scale satellite or aerial data (e.g., Tellman et al. 2015). Additionally, visual data provided by different types of optical sensor devices offer different spectra of visualization (see e.g. Van Westen 2000, Domenikiotis et al. 2002). They can be sensibly included to enhance the overview of critical or escalating events. They are also verifying, upgrading and supporting the common intelligence delivered by physical eyewitnesses or sensors at the site of the event. Whereas they are conveyed either by traditionally qualified in-house sources generated in field missions or by digitally facilitated sources like citizen-sensing or crowdsourcing (see Rainer et al. 2016) this additional set of data can overcome current obstacles. Thus, remote and inaccessible areas, hostile climate or weather conditions, unclear and instable situations, or additional hindrances for common visual contact can be tackled and questionable information can be verified or to a certain extent objectivized.
Examples for the inclusion of additive data, sensors, and data sources supporting the creation of an enhanced operational picture are at this time developed and validated in several security research projects. The recently finalized study EBeCa, the currently running WatchDog (both funded and financed in the course of the national KIRAS security research programme by the Austrian Federal Ministry of Transport, Innovation and Technology, see sections 2.1 and 2.2) and several other national and international approaches will be outlined to show their added value for crisis management.
Although some few data sources and selected sensor data is already well verified and established either for small scale, everyday use of emergency management or already for the inclusion into the crisis management processes, section 2 elaborates on specific examples, the occurring gaps and needs. Technical exchange of this information as well as the legal and ethical framework settings are

consolidated and facilitated only on a very basic level, if they are considered and installed at all by the end-user organizations, regional, national, or international regulations.
In this regard the mig.data-approach (see section 4), showing exemplarily an inclusive, holistic source and sensor approach contributing to the basis of a planned research project, will be outlined. The showcase of an enhanced exchange of multi-source data among relevant stakeholders for the timely and efficient handling of crises with mass inclusion or events prone to develop to this scale can stand as feasible example.

2. Data Collection and the Challenge of Interoperability – Enhancing the Operational Picture by Sharing Information

The collection and discrete use of some selected sensor systems is already a good and common practice in some organizations. Given the necessary legal, ethical, and organizational frame for the collection of different types of data – not to forget the discrimination between individual-related and anonymous information – there exist several examples that outline, how and under what restrictions data can be used to enhance security and to (potentially) feed into a holistic operational picture. In addition to these factors, the question, potential, and obstacles of an information transfer to other relevant stakeholders is pointed out in the following sections.

2.1. Visual and Audio Data Sources in Security Contexts

2.1.1. The Concept of the Study EBeCa: Visual and Audio Sensor use

EBeCa, the project on the "Evaluation and monitoring of the launch of Body Worn Cameras. Response analysis, societal perception and recommendations for accompanying measures regarding the launch for police use in Austria" was conducted by the Agency for European Integration and Economic Development in cooperation with the Austrian Federal Ministry of the Interior in the years 2015-2016 (EBeCa 2015). The study – funded by the national security research programme KIRAS by the Ministry of Transport, Innovation and Technology – showed the strengths but also the limitations of the use of visual and audio data gathered under a strict legal regimen in a pilot test among the Austrian police.
EBeCa focused on the socio-cultural, proactive monitoring and support of the test use of Body Worn Cameras (BWCs) also known as "body cams" or body worn video systems in the Austrian police context (Rainer, Levy 2016). This innovative technology, which records official acts of police officers, has been tested and implemented in other countries (e.g., USA, UK, and Germany) since more than ten years. Trials of BWCs were recently also conducted in Austria due to the demand for even greater transparency and better documentation of actions.

Figure 1: BWCs in the Austrian police context (Copyright MoI (BM.I): Alexander Tuma)

Apart from the legal prerequisites addressed by an initiative for an amendment of the current law by the Federal Ministry of the Interior, the use of this assistive documentation technology required thorough counselling and research on social and ethical considerations as well as on communication aspects. Expectations, fears, and acceptance-screening of all involved groups was a key focus, considering examples of the broad population, the law enforcement officers, their superiors, and ethical experts.

The study EBeCa started with a comprehensive desktop research on international experience reports and findings on the use of BWCs in order to carry out an evidence-based evaluation of this innovative technology in use. In general, state of the art results reveal a rather positive attitude adopted both by citizens and police officers towards the use of BWCs. The review of recent literature on this topic (Goold 2002, Zimmer 2011, Stanley 2013, Wilmink 2015) resumes main positive effects of the implementation of BWCs in police work as follows:

- reduction of the crimes, due to the open and visible recording of facts,
- less violence against police officers,
- more convictions at an early stage, more confessions in advance,
- fewer false accusations due to video and audio recording,
- less public costs due to video and audio recording (court, lawyer, police costs)
- enhanced perceived security by citizens,
- acquisition costs for the cameras are profitable in a short time.

Less aggression creates a safer environment, both for police officers and civil society. Moreover, studies show that wearing BWC improves the self-confidence and reliability of the wearer.

On the other side, the effectiveness and efficiency of the security measure is permanently contested in the light of the overall debate on (video) surveillance and data protection issues, as well as regarding the question whether "typical conflicts" such as hate crime or domestic violence, which often occur spontaneously and emotionally, can be reduced by using BWCs.

After the analysis of the data available on the international state of the art regarding BWC, the EBeCa project conducted a preliminary study and a pilot test run in Austria to collect empirical values regarding the use of BWCs. This data lined out the perspectives of all three identified stakeholder groups: participating law enforcement officers, officers on police leadership level, and the civil society.

For the empirical relevance of the trails, three test situations were used in EBeCa for monitoring purposes in narrative and qualitative terms. Different basic conditions refer to possible, typical utilization scenarios for BWCs in the daily work of police officers. The scenarios describe situations

with mass involvement (e.g., demonstrations, crowd gatherings in sports or cultural context), critical situation during the patrol duty, as well as cases of domestic violence.
In accordance to the findings from international reports, the result from the preliminary field study in Austria show a predominantly positive attitude towards the use of BWCs among all stakeholder groups. Most respondents considered significant factors of the technology acceptance analysis, such as openness, curiosity, technical experience, or usability, as positive. All stakeholder groups see the most significant strength of BWCs in the protection of the acting officers and other involved parties against unjustified accusations.
Nevertheless, some of the first-line test users within the police, as well as participating representatives of civil society, feel little informed regarding the implementation process of BWCs in the police context. Negative perceptions are related to financial issues, considerations regarding the total surveillance by the state, data protection and misuse, as well as to additional stress, caused for the first-line practitioner. On the other hand and in addition to the mentioned issues, the managing police level evaluate the weaknesses in the technical field (e.g., image quality or perspective constraints).
During the test phase, respondents clearly emphasized and confirmed the previously outlined strengths of BWCs: the protection of involved people, objectification, traceability, evidence management and monitoring, prevention of violence, and transparency. It was also reported that the potential of de-escalation during the use of BWCs was higher than expected. The weaknesses indicated refer to data protection, permanent monitoring of police officers, and increased administrative work. Regarding the successful implementation of BWCs in the Austrian police practice, stakeholders pointed out the demand of a defined legal framework, trainings for the implementation process, as well as high usability and user-friendly devices.

2.1.2. Further Results of the Data Inclusion surveyed by EBeCa

Other results of the project focused on concrete recommendations for a future requirements-optimized implementation of the technology, specially tailored to the target group of the national police force. They consist of practical outputs such as concepts for accompanying measures or training and communication checklists. This specific material supports the subsequent implementation of the BWC technology.
The generally positive attitude of all stakeholders groups involved in EBeCa towards the innovative technology on BWCs constitute a great potential for the acceptance of the system as well as for the further implementation of it in the Austrian police context. This favorable attitude was recommended to be supported by transparent communication measures (see also Miller et al. 2014). This would facilitate keeping both, the first-line users and the civil society, well informed with regard to expected technological improvements and developments on the level of public authorities and law enforcement agencies.
As EBeCa gathered with an overview of good practice examples of everyday use in international security and response organizations, taking advantage of these partially validated and useful sources of data can be found in police use as well as in disaster management as outlined by Backfried et al. (2013). Up to the current date, the inclusion of all of these outlined positive factors are not in full scale actively installed in scenarios with mass involvement. Additionally to the primary, BWC-technology-specific data gathering prone for small scale interventions, documentation units are currently used to gather footage from vantage points in dynamic and complex scenarios with mass involvement like demonstrations or big scale events. This data is still mainly used for retrospective use specifically as evidence in lawsuits or to tackle unjustified accusations (see e.g. Sherman 2013).
The gathering of visual and audio data and their transmission in (near) real time to support an integrated operational picture at a command and control center was thus not surveyed in the EBeCa-approach. The question of the current feasibility and integration possibilities due to pending questions

on technical, legal, and ethical issues as well as financial aspects has to be considered when debating the extension of use of visual data in complex scenarios with mass involvement and data sharing and exchange for an enhanced operational picture.

2.2. Additional Optical Sensor Sources and Data Distribution in Security Contexts

2.2.1. The Concept of the WatchDog project: Additive Optical Data and Data Distribution Models

In addition to the focused, but thus also limited data gathering approach of EBeCa, the project WatchDog represents the virtual and literal example of a more holistic, enlarged view on potentially escalating and dynamically changing situations with mass involvement.
The cooperative research and development project "WatchDog. Mobile communication and multi-sensor solution for security and risk management for outdoor areas and object security" was started under the lead of Joanneum Research by a consortium combining technology and sociology research institutes in tight cooperation with relevant governmental end users and NGOs in the year 2016 (WatchDog 2016). The key to an optimized operational flow of command and successful management of different risk situations consists of an innovative, semi-autonomous and autonomous permanent 24/7 time-optimized generation of a situational overview. In WatchDog – funded by the national security research programme KIRAS by the Ministry of Transport, Innovation and Technology – a concept for a mobile communication and multi-sensor solution for security and risk management for outdoor and object security is elaborated, tested and evaluated. The goal of WatchDog is the development of a multi-sensor system for security scenarios that is self-sufficient and independent from currently common communication infrastructure to enable the support of time critical decision processes.
The intensive involvement of first responder groups, application-oriented industrial partners, responsible representatives from the BM.I (Austrian Federal Ministry of the Interior) and BMLVS (Austrian Federal Ministry of Defence and Sports) as well as an international expert board ensures focused, practice-oriented alignment of research tasks and a scenario oriented development of prototype solutions.

2.2.2. Focus, Use Cases and Requirements of the WatchDog approach

A targeted analysis of the requirements focuses on the following application scenarios:

1. monitoring of transit and border areas
2. monitoring of industrial facilities and critical infrastructure
3. monitoring as part of security tasks in urban areas and public events
4. camp protection under humanitarian missions of the Federal Army

The following figure provides an overview of an exemplary WatchDog backup scenario for the monitoring of border areas and in transit zones.

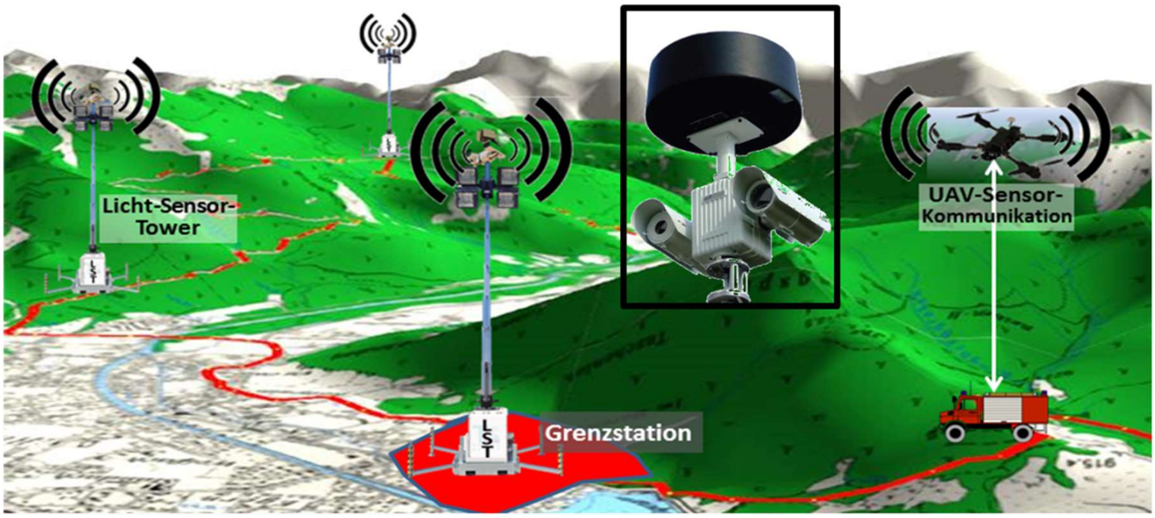

Figure 2: The WatchDog model for collecting multiple sensor data in areas with mass gatherings – example of border security

Different, often very dynamically changing security situations and the required efficiency in human resources, increase the demands on emergency and security services, as well as relief organizations at the same time. The recent past has shown this incisively with the problems at the borders as part of the international refugee situation, as well as critical developments of security situations in frame spontaneous events and planned events (sports events, cultural/music festivals, large New Year's Eve parties, etc.).

Therefore, WatchDog develops a flexible, mobile telescopic mast system, an energy and communication self-sufficient multi-sensor system concept adding up to the current state of the art in the automotive sector according to Hasch et al. 2012. The system will allow an efficient support of different large scale security scenarios. Thus, the integration of optical and thermal sensors as well as an innovative, but focused radar module is intended while excluding additional, highly specialized applications as Armbrecht et al. 2011 or Ash et al. 2014 outline. This selection and combination allows the development of multi-sensor-based analysis methods and management modules to account for a near-real time generation of a situation overview to support operation command and time-critical decision-making.

In the context of the defined sensor concept, the integration of radar data is used as an essential feature for the assessment of the situation and provides important motion information, especially in critical lighting conditions and at night. Therefore, the joint analysis of these sensor data will enable improved and more stable results in object detection and motion analysis. For flexible operation, the concept relies on innovative, energy-independent mobile telescopic mast systems equipped with the WatchDog communication and sensor modules. Innovative, LED-based lighting systems and speakers can be integrated to support security measures. A further essential part to optimise the support of the operational management for ground teams is the decentralized data access, an optimal group- and roll-oriented data distribution and standardized interfaces for a simple data integration in existing systems.

The aimed solutions in WatchDog will enable a near real-time situation picture, supporting the common operational picture to provide targeted information for the security management. Therefore, they increase the safety, security, and timely provision of the affected people. This underpins the importance of the generation of evidence

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

3.1. Need for Improved Information Sharing

A predominant requirement in multiple domains of crisis and disaster management as well as other security domains such as management of migration movements is improved information exchange. Nowadays, collaboration between stakeholders such as authorities, first responders, or military services is still 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 (Neubauer et al. 2017).
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. To make this "seamless" information exchange possible, an approach is the development of an adaptor to the CIS 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 frequently 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. Due to the evident and well documented current situation expressed by response organizations and their leading staff (see section 4), a need for an enhanced operational picture for sensing early signs or even prediction of movement of masses was expressed (e.g. Neubauer et al., 2017). 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 people, their socio-cultural constellation, and thus their specific vulnerabilities and needs to be covered. Provisions and preventive measures, prone to minimize certain dangers or risks can result in a timely and more precise, granular picture. This 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 represents an imminent challenge. These novel or not yet sufficiently included sources and sensor types as well as the implementation of a bigger, selectively used pool of reliable jigsaw pieces have the potential to constitute the holistic and necessary knowledge of the scenario.

3.2. Inclusion of Additional Sensors and Data Sources in Small Scale Scenarios

Another example of the inclusion of sensors and data sources up to date not broadly used in the mentioned crisis scenarios is the use of analytical outputs of chemical sensing. As shown in a recent research project and current pilot test, DHS-AS validates the detection of persons in a scenario of smaller scale. The project DHS-AS, “Detection of human signatures to detect smuggling”, was started in 2016 under the lead of the University of Innsbruck and is funded by the national security research programme KIRAS by the Ministry of Transport, Innovation and Technology (DHS-AS 2016).

This project aims for the development of a portable device, which combines a gas sensor system for detection of trace volatile compounds characteristic for humans and an infrared camera to measure the person generated heat. The gas sensor system detects similarly to the dog’s nose a “chemical fingerprint”, composed from volatiles compounds, which are emitted by the human body through breath, sweat, skin, urine, and faeces. The applied sensor system has short analysis times of few seconds allowing a frequent and continuous sample collection and thus measurement of concentration gradients required for odour based searching scenarios. The prototype developed will be validated in field trials together with the partners at the Austrian Federal Ministry of the Interior and the research department of Johanniter Austria and optimized for future connectivity to current systems.

The planned portable system may open up completely new perspectives for different search and rescue scenarios. They can be used in situations with the involvement of groups, multiple persons or for individual search. These scenarios of trapped or hidden persons can appear after natural disasters like earthquakes, explosions or terrorist bomb attacks, as well as for searching illegal immigrants in in vehicles and vessels, which provide the danger of suffocation due to the lack of ventilation and oxygen.

Having derived an improved operational picture from multiple types of data sets, the impact can additionally be improved by enhanced sharing relevant and thus selected information with other stakeholders involved in the management of moving masses. Such collaboration models and inclusive approaches have very high potential in trans-national scenarios such as in border crossing areas as recent research showed, with a different focus on the examples of electronic health data transfer (www.konfido-project.eu, Naddeo et al. 2017) and railroad traffic (Maly, Schöbel 2009).

4. Initiatives and Approaches to Include Multiple Sensors and Exchange Data

4.1. Research Initiatives related to an Extended Exchange of Data

The mentioned recent initiatives show ways on 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. Current approaches are not only retrospective or reactive alone, but pro-active and consider specific needs and inherent structures of the moving groups. As outlined, they are not yet rolled out to harvest the full benefit of the data for supporting a (near) real time operational picture. This situation led to multiple research initiatives, both on national as well as international level. The project WatchDog and other research projects in the pipeline e.g. the mig.data-approach show the importance of the inclusion of multiple different sensor sources to provide novel perspectives.

For instance, demonstrators of such a CIS were developed in several European research projects. The focus of these CISs’ differed considerably. In the frame of the FP7 project EPISECC, “Establish a Pan-European Information Space to Enhance security of Citizens”, the developed CIS allows message exchange of stakeholders with specific focus on the response phase (EPISECC 2017). The use of adaptors allows seamless interconnection of proprietary IT solutions. In the case of EPISECC key terms of the messages can be semantically enriched (see Figure 3).

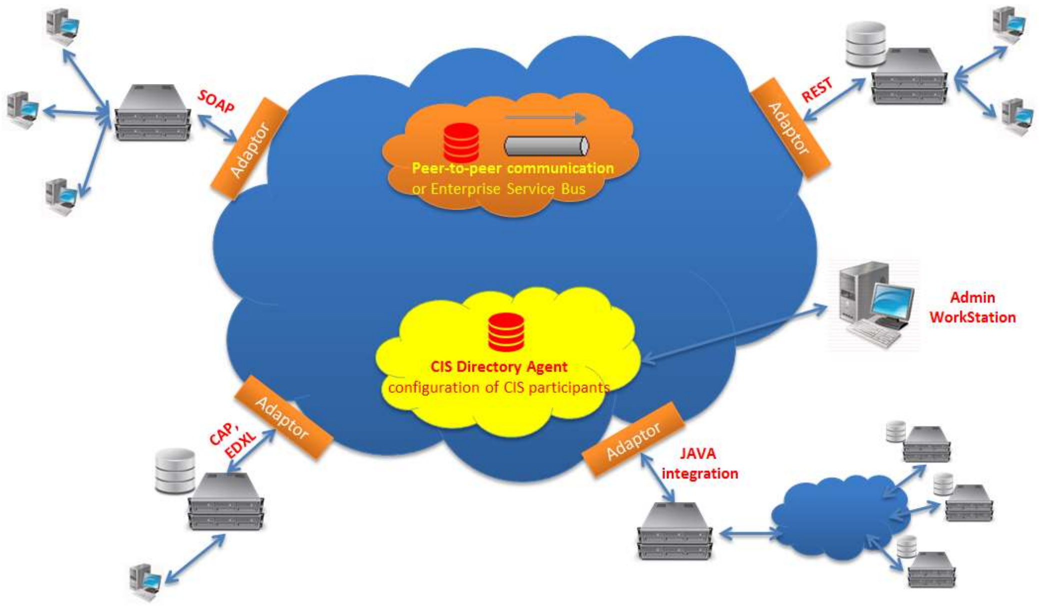

Figure 3: Concept of a Common Information Space from the FP7 Project EPISECC (EPISECC 2017).

In contrast, the CIS developed by the FP7 project team of SecInCore (Secure Dynamic Cloud for Information, Communication and Resource Interoperability) supports information sharing and retrieval for preparation activities (SecInCore 2017). Other projects were focusing on adaptation of communication technologies like Redirnet (Emergency Responder Data Interoperability Network) (Redirnet 2017) or integration of different types of legacy systems as SECTOR (Secure European Information Space) represents (SECTOR 2017). The Austrian national project INKA (Interoperability between Civil and Military Organisations in Catastrophe Management) allows exchange of information between civil and military command and control systems (INKA, (2017)). 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 types of sensors.

4.2. The Relevance of Information Exchange for Managing Mass Movements

A major challenge for European governmental organizations as well as NGO's is the management of the refugee flows that reached a peak in the second half of 2015 for the time being. It has been shown that the stakeholders on all levels had to face a lack of information on ongoing refugee movements (see Neubauer et al. 2017). Thousands of refugees reached different European borders and confronted stakeholders with hardly manageable challenges. It turned out that both established border-crossing information-exchange between stakeholders as well as early detection of refugee flows are main requirements to enable better management of movement of displaced persons. Taking into account the hardly predictable political, economic, as well as environmental developments in the multiple crisis regions in the world, such as Syria or Eritrea, it is highly recommendable to support stakeholders to be better prepared for managing future refugee flows. Such initiatives need to ensure both seamless, borders crossing information exchange as well as improved operational pictures on ongoing and expected refugee movements. In order to realize optimized information exchange, the use of concepts of information platforms such as the CIS developed in EPISECC or SecInCore and the adaptation to the specific requirements of the management of migration movements. Looking at an enhanced operational picture allowing short and middle term prediction of movements all relevant sources of information need to be combined. Such data encompass satellite data, organizational data from authorities, as well as data from conventional and social media in form of reports and statistic. Based on these types of data on migration movements as well as push and pull factors a data model needs to be developed allowing retrospective evolution of operational pictures as well as short term and middle term forecasts of migration movements.

4.3. Enhancement of the Operational Picture via the Combination of Additional Sources, Data Exchange, and Process Development

Another innovative approach currently in evaluation to be funded is the mig.data-model that aims at connecting the mentioned data gathering via multiple sensors with the necessary procession, learning process, and sharing of information among relevant stakeholders. This approach originates from the requirement analysis and needs assessment among NGOs and Austrian national stakeholders after the big migration movement of 2015 and 2016. It multi-disciplinarily addresses the problem that authorities and other involved actors are still partially lacking relevant information on the overall operational picture of ongoing and expected migration movements.
This operational picture was also only shared in a limited way between states and stakeholder organizations. Based on heterogeneous information of migration movements and push-/pull-factors basing on satellite data and organizational data from authorities as well as conventional and social media in form of reports and statistics, a model and a demonstrator for an enhanced operational picture is going to be developed. This demonstrator will deliver actual respectively retrospective operational pictures and forecasts of expected migration movements. This operational picture can be shared on-demand on an inter- and inter-organizational basis via standardized interfaces.
Complementary to that, an e-learning concept will foster suitable training measures for working on the operational picture monitor. To receive the required adequate information level, data sources as well as relevant push/pull-factors are identified and brought together via Extract-Transform-Load (ETL) processes regarding a harmonized data model, which is based on standards to further push interoperability in this field. These ETL processes go along with a logical combination and, as far as possible, refinement of data regarding overall quality improvement. The derived operational picture will be complemented with geo- and context relevant information and in the end, will be visualized and interactive rehashed for the respective stakeholder groups.
As sustainable result, the mig.data approach delivers an extendable model to calculate and forecast migration movements and the necessary ETL-processes for generating data as integrative part of a developed and validated demonstrator, together with the appropriate e-learning concept for supporting the stakeholder during mastering migration movements as the following figure shows.

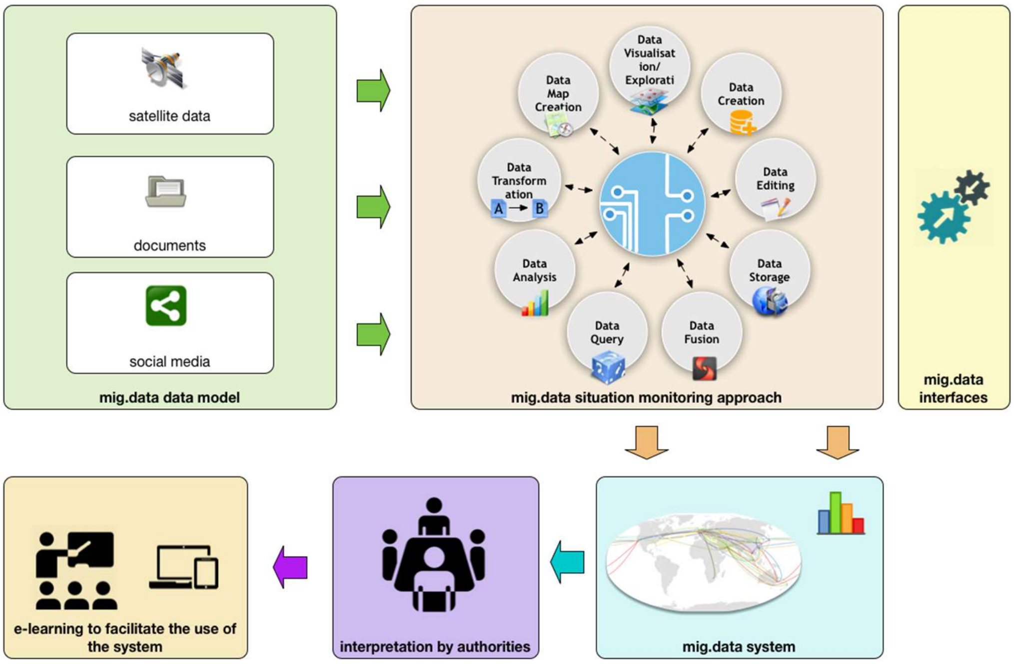

Figure 4: Overview of core elements and process steps contained in the mig.data approach

Finally, the benefit for all involved groups – users from authorities, NGOs, but also migrating groups – is a targeted, efficient, and timely possibility for the preparation of provisioning and support measures. Situational security and stable structures for the first care and handling of mass movements can thus be supported to a bigger extent than before.

5. Open Issues on the Legal, Ethical, Societal and Technical Side

These new types of models, sensors, and data to be included to a pool of selectively used data raise also new questions and requirements. Adding up to the technological challenges to be handled in the development, pilot, and roll out phase, several open issues evolve on the legal, ethical, and societal side. On the technical side, data security and transmission of partially enormous quantities of potentially sensitive data have to be solved in accordance with the organizational, operational, and last but not least financial possibilities of governmental and non-governmental stakeholders.

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 the enhanced security and safety of groups. Specifically the legal compliance with national and international law has to be considered and is besides the social and ethical acceptability of these systems a key factor for further research and in the last consequence for the practical implementation.

The monitoring through visual sensors like the EBeCa study exemplarily showed for BWCs represents a rather critical issue from the data protection point of view. In accordance to all regulations, police officers equipped with BWCs are required to mark on their uniforms while using BWCs. However, police officers don´t have access to the recorded materials. The processing of the recordings is carried out by a responsible office on management level, who decides whether the recorded material is important or not.

Compared to CCTV equipment, which is fixed in a certain place in the public space, BWCs are worn directly on the body. The main focus of CCTV lies on space control, while BWCs concerns the control of the situation and actors in place. The awareness of the fact being monitored, even if the device remains switched off, is theoretically more pronounced in the latter case.

Findings with critical or even pessimistic statements outline the possible negative impact of the utilization of BWCs on the relationship between citizens and the police. Since the monitoring camera is always present, even if it remains switched off, it performs control on the behaviour of individuals involved in critical situations. The permanent monitoring as well as the pressure of conformity are impacts which could increase the gap between police and the civil society (see Miko 2010, Silvestru 2012).

Even more pressing are the legal, ethical and technical questions to be considered in the research and development project WatchDog (see section 2.2). Due to the enlarged focus of the data gathering and sensor application via semi-autonomous and autonomous devices and the aspired multi-sensor solution, issues like data protection, security of transmission, the legally and ethically correct use of the system in different scenarios are key to create a practice oriented and in the further consequence also acceptable and applicable system.

The subjective feeling of diffuse threat in the host population that has developed specifically among persons living near critical borders in the course of the mass movements in 2015/16 as elaborated by Bourbeau (2015) is one of the factors to be closely surveyed. Besides a lack of information and the doubt of the governmental ability for sufficient preparation, management, and protection of exposed areas, the question of the acceptance of the local population – but even more so of the migrating persons – have to be taken into account. The subjective feeling of security/insecurity is also interlinked with cognitive aspects like the cost/benefit-ratio, the emotional and also the conative acceptance of surveillance technology as de Buitrago (2017) shows.

Additionally, gender issues as well as cultural and socio-psychological aspects are evidently of high impact for a complex solution as the WatchDog-approach but also for the other technology examples outlined in this paper. In regards of the project DHS-AS it can be seen as crucial to include the possible cultural and socio-psychological background of smuggled persons. When they are confronted with the chemical sensor, it might resemble a weapon and thus being considered severely threatening which can lead to over-reactions, non-compliance with the authorities, or traumatisation. In general the perspectives of male and female users of technology have high relevance for the successful and targeted research and development. In addition to that, the point of view of the subjects of this data collection are to be considered and respected. The specific reactions of the different genders as summarized by Gilbert (2010) have to be respected and included accordingly into the successful R&D-cycle.

Thus, in all of the presented, technology-focused projects like WatchDog, a thorough analysis of these aspects from the perspectives of all of the involved parties – official stakeholders, local residents and the individuals of the secured “masses” – has to be conducted.

On the level of data exchange and forwarding of requirement-focused, multi-source information, as outlined by the project examples of EPISECC and also the mig.data approach, these aspects have to be included and researched on a meta-layer. The systemic and procedural framework of the organizations meant to interact fluently in crises with mass involvement have to be taken into account with their individual needs, strengths and current technical, human, and infrastructural layout. Besides the early inclusion of the end user perspective and their specific requirements in this highly complex and dynamic field, these practicalities have to be taken into account additionally to the legal and ethical acceptability of innovative solutions. Only by combining all of these prerequisites and pre-conditions, solutions prone to be adopted broadly – as the trans-border and trans-disciplinary issue requires – can evolve from these inclusive, scientific approaches (see Conley 2011).

6. Conclusion

Rounding up the additional possibilities and the potential of an inclusion of novel sensor data and extended data exchange it becomes obvious that, besides the already existing data streams, much more is possible and needed for generating an enhanced operational picture for the response to crises with mass involvement. As exemplarily shown via several current research projects or singularly successful implementation show cases, the end users in governmental and non-governmental stakeholder organizations explicitly state the need for enhancement in information exchange and a holistic, timely, validated, and requirement-focused information basis.

Up to now, only a limited selection of the diverse spectrum of available sensor types is used in the domain of crisis management. Due to this current restriction, multiple data sources are not yet tapped to be included into a holistic and potent operational picture in scenarios with mass involvement and dynamic development. Thus, not only technological research in order to develop more and useful sensors for data gathering, but above all the inclusion of multi-use approaches of current and perhaps already validated and included data sources in other fields is vital. It has to be highlighted that the aspects of the efficient management, requirement-focused selection, and safe transfer and inclusion of data, but also the exploitation of novel data sets for innovative solutions are core elements for the optimization of an evolving, overall operational picture.

Besides the relevant, mostly quantitative basic information in scenarios with mass involvement, that were partially already implemented by national authorities, these additional data sources can contribute to filling gaps and enhance a fluent ongoing process chain. Data adding up to simple head counts or stream analyses can help to prepare sufficient shelter, support, and infrastructure pinpointing the requirements of the moving persons. Thus, for example the specific needs of vulnerable groups like children or elderly can be taken into account in a timely manner. Also, special patterns for the set-up of support structures or shelters dividing rivalling or culturally adverse groups can be prepared timely and thus conflicts or unrest can be minimized.

Additionally, by involving multiple data sources and sensors, the operational picture is less prone to disruptions, better validated, more stable and not depending on single channels, that can be easily blocked or that are not always available due to the environmental conditions, such as flooding. Apart from this beneficial potential of the inclusion of multi-sensor data in an enhanced crisis management, the processes lying behind have to be identified, analysed, and openly discussed for the different structures of the end-user organizations. Aspects in regards of human resources and training, an adequate cost-benefit ratio, evidence based findings for the validity and stability of the inclusion of innovative sensor data will be vital for a successful development towards the enhancement of an operational picture.

Last but not least, if not properly addressed, these legal, ethical, but also gender- and culture related issues, expectations and fears represent a high risk that the internationally evident positive effects of the combination of different data sources, information, and the selective exchange are overlain by negative representations. Lack of information and of responsiveness to these concerns and expectations may result in a negative attitude towards a new technology and thus hamper the acceptance of potential users. Thus, it is necessary to bring together in an early stage the perspectives of the potential first line users in local or national authorities, NGOs, and additional relevant stakeholders and experts as well as the broad view of the population and the migrating groups as well.

7. References

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