Utilizing Social Media and Crowdsourcing for Crisis Management and Communication: proposing an Integrative Framework

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ABSTRACT

Utilizing social media and crowdsourcing (SMCS) in crisis management is crucial for improving communication and citizen engagement. However, practitioners working in crisis management organizations often face challenges when translating the outcomes of scientific research into actionable knowledge. To aid disaster management organizations, a comprehensive set of resources including practical tools, guidelines, and use examples are necessary. This will help response organizations to integrate the different components of SMCS coherently and consistently in their organizations and to promote disaster resilience for different users. An integrative Framework, developed by the authors as part of the EU-funded Horizon 2020 project, LINKS – *strengthening links between technologies and society for European disaster resilience*, serves such resources. This paper presents how this Framework came into being and describes its main components. It then provides a case study from the Netherlands, focusing on the scenario of industrial, chemical hazards, to illustrate how the Framework was actually used.

Keywords

Social media, crowdsourcing, crisis management, disaster resilience, integrated framework.

INTRODUCTION

Beginning in the early 2000s, professional first responders, citizens, and local community members started to use social media platforms during crises to obtain information and assistance. Since that time, the use of social media platforms have been studied, and many empirical studies gave evidence to the benefits for improved crisis management and crisis communication (Vieweg et al., 2010; Meier, 2012; Burgess et al., 2013; Hughes & Tapia, 2015). Indeed the integration of social media and crowdsourcing (SMCS) in crisis management has become increasingly important in recent years (Imran et al., 2018; Reuter & Kaufhold, 2018; Lovari, 2020; Haupt, 2021; Mavrodieva & Shaw, 2021; Harrison et al., 2024). This is due to its potentials for enhancing citizen engagement and improving communication during disaster situations.

Researchers have found that the use of social media in crisis management can greatly enhance disaster resilience. The usage of social media platforms can help with the quick collection and sharing of crucial information, tapping into the *collective intelligence* (Bruns et al., 2012, Palen et al., 2009; Palen & Hughes, 2018). Social media can also provide a platform for citizens to share information, mobilize resources, and coordinate activities (Reuter & Kaufhold, 2018; Reuter et al., 2018), and facilitate collaboration and coordination between disaster management organizations and citizens – to which we refer with the term crowdsourcing. The platform Ready2Help, developed and utilized by the Netherlands Red Cross provides a perfect example (Schmidt et al., 2018; Boersma et al., 2019. This initiative utilizes an app to activate members from an extensive network of nearly 100,000 volunteers during emergencies.

However, practitioners working in the field of crisis and disaster often have a hard time translating the outcomes of scientific research into actionable knowledge. This paper focuses on how SMCS can be adopted by first responder organizations and argues for organizational change toward disaster resilience in a Dutch case study related to industrial (chemical) hazard scenarios. The main objective is to help disaster management organizations to improve crisis communication and citizen engagement. To this aim, this paper proposes an integrative Framework for implementing SMCS into crisis management, which can address the challenges that come with the use of social media in disaster situations. By bringing together different components required for successful SMCS utilization, the Framework can help disaster management organizations to navigate the complex landscape of social media communication and address challenges such as information accessibility, credibility and relevance, and misinformation. Furthermore, it can help ensure that all populations, including vulnerable ones, have equal access to timely and accurate information during disasters.

In the remaining part of this paper we would like to propose an *integrative Framework* that could support (research into) organizational, institutional change towards disaster resilience by enhancing knowledge for improved communication and citizen engagement. We will present a case study from the Netherlands to show how the Framework can be utilized. The case focusses on three organizations and their stakeholders: the public organization *Safety Region*[1] *of South Limburg*, responsible for managing emergencies and communicating risks to the community; *Sitech Services*, a technical service provider that offers advice and support to companies on emergency services at the *Chemelot site*, an industrial multi-user site and research campus that houses sixty-four industrial – mainly chemical - plants and about one hundred and fifty organizations, with over eight thousand employees.

SOCIAL MEDIA AND CROWDSOURCING: OPPORTUNITES AND CONSTRAINTS

Social media play an important role in disaster community resilience by enabling crisis communication, encouraging citizen involvement, and giving access to key information. It may give useful real-time data and information from many sources, boosting perception of the situation on the ground and helping disaster management organizations to respond more effectively (Apuke et al., 2018). Social media assist emergency response groups in communicating with the public, allowing for real-time updates, early warning systems, and the transmission of crucial information during a crisis. It can also help them to provide valuable data and information to other emergency management agencies to make informed decisions.

Social media has become an essential tool in crisis management for disaster management organizations and stakeholders, helping to engage with citizens, improve communication, increase public awareness, and ultimately save lives. SMCS has a great potential in engaging citizens in disaster management activities and to provide insights into integrating citizen-generated content for a more accurate response. Effective communication

[1] In the Netherlands, a Safety Region (Dutch: Veiligheidsregio) is a public body whose task is to facilitate regional cooperation in dealing with crises, disasters.

strategies that consider diverse needs and perspectives are necessary, particularly for vulnerable populations. SMCS also demonstrated importance in successful crisis response and recovery by facilitating *social connections*, which is especially important since social media may be used to organize response activities, mobilize resources, and offer real-time information to impacted people (Bukar et al., 2022).

These and many more studies have provided evidence that using social media in crisis management may significantly improve disaster resilience, crisis communication, and response efforts. *However*, incorporating social media communication strategies into crisis management has to overcome a number of obstacles.

First of all, there is a *practical* constraint as most response organizations lack the recourse and the organizational routines to integrate SMCS into their day-to-day (operational and strategic) practices (Boersma et al., 2016; Nielsen et al., 2023). If SMCS tools are not carefully integrated in crisis management plans, protocols and organizational routines, its effective and efficient use during crises cannot be ensured. In practice, the implementation of SMCS in organizations remains a struggle.

Secondly, while studies have shown the usefulness of SMCS for engaging citizens in crisis management and communication, they also revealed the *exclusion* of disadvantaged groups from essential information because of issues with information accessibility, such as the digital divide and language barriers. This exclusion can lead to a lack of timely and accurate information reaching those who need it the most, perhaps exacerbating the effect of a crisis (Lovari et al., 2020; Pérez-Escolar & Canet, 2023).

Thirdly, the rapid diffusion of information on social media platforms can lead to the *spread of disinformation*, which we have in particular seen during the COVID-19 pandemic, and which can have serious consequences during times of crisis (Fernandez and Alani, 2018; Burel et al., 2021). Misinformation travels quickly and widely, undermining public faith in official information sources and creating public doubt. This has the potential to aggravate the problem and make reputation management more difficult (Roshan et al., 2016). Therefore, crisis communication plans need to be designed to identify and address misinformation, while also ensuring that accurate and relevant information is disseminated promptly and in an inclusive way.

A way forward to overcome such challenges is to develop and use an integrative Framework that can help stakeholders working in disaster management organization to utilize existing insights and focus on what's important when considering the application of SMCS in disasters. Furthermore, it can help in strategic thinking especially in the planning phases, and guides disaster management stakeholders through existing knowledge based on the objectives and needs of their organization.

METHODOLOGY

The data collected for this paper has been part of a project, called LINKS "Strengthening links between technologies and society for European disaster resilience", funded under the H2020 Research and Innovation Program, Disaster Resilient Societies (DRS). LINKS aimed to address the challenges of SCMC for crisis management and communication (Clark et al., 2024). An important outcome of the LINKS project is an integrative Framework that can serve as a knowledge resource for disaster management organizations and other relevant stakeholders to guide them in applying SMCS in disaster risk management. The guidance through the Framework is organized under two thematic areas: 1) engaging with citizens and 2) improving crisis and risk communication. The Framework has a user guidance, which provides simple access to the tools in the Framework through a dedicated website. A visualization of the Framework is presented in Figure 1, and detailed information is provided at the LINKS website: https://links-project.eu/links-Framework/.

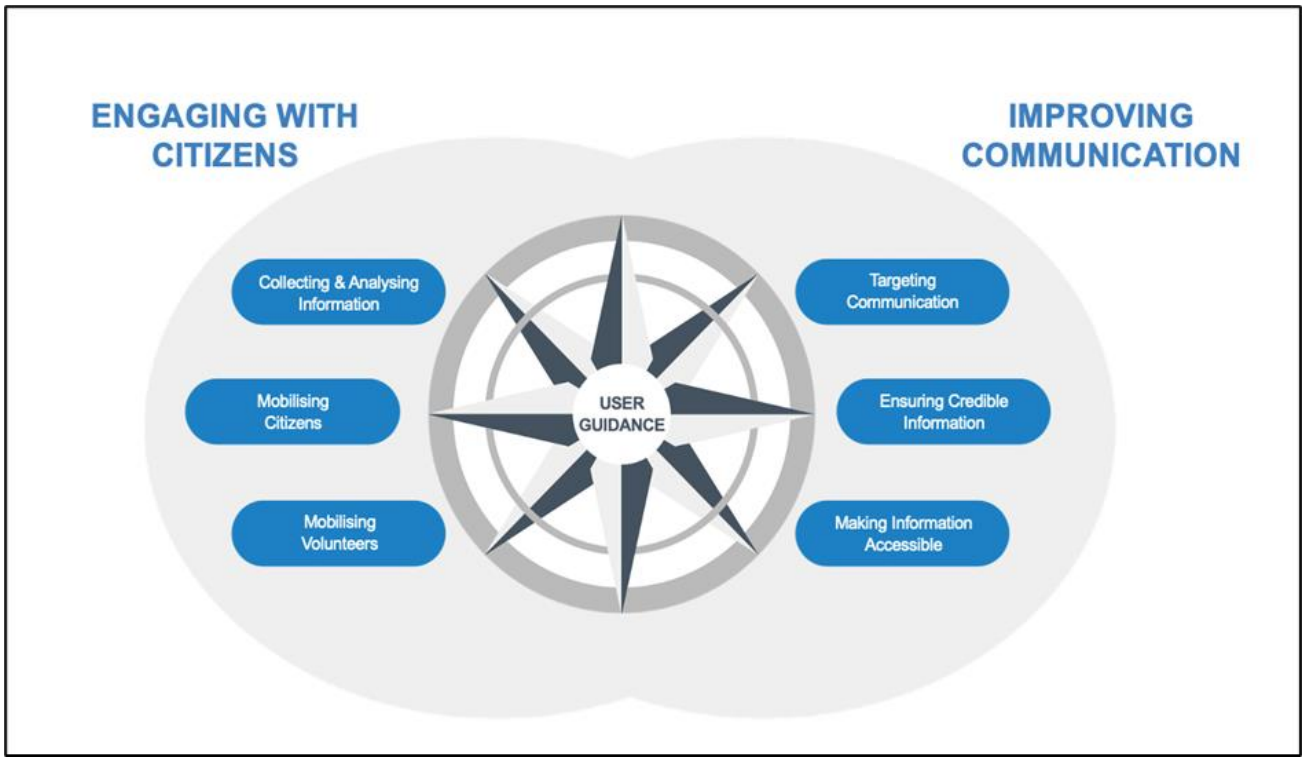

Figure 1. LINKS Framework adopted from Fonio et al., 2022

The Framework has been developed via an iterative process and based on a *participatory research approach* (Barreteau et al., 2013; Boersma et al., 2022) and on *action-research* (McNiff, 2013). The participatory dimension of our approach refers to the *co-creation* process that we adopted: in all phases of the research and the development of the Framework both academics and practitioners were involved from over 20 organizations. Usually it is hard to include citizens and community members in crisis management (Ferguson et al., 2018) but the Framework has been developed closely together with community representatives, labelled community *ambassadors*, whose role is explained in detail below. While the first few workshops were not organized in coordination with community representatives, over the course of several workshops the feedback from previous workshops and contacts in the field (both government and citizen contacts) have been used to better organize our workshops so they would be more appropriate for the audience and the needs. Currently this network is still used, in particular for communicating risk. On the long term this network has a big potential for active communication during a crisis.

In other words, the approach was action-oriented as the Framework was used as a tool to *intervene* in crisis management organizations to create organizational routines for the utilization of SMCS. The Framework was developed though different stages to do justice to both the participatory and the action-oriented dimension of the research.

In the first phase, we conducted 67 semi-structured interviews and an online survey with 284 responses across Europe to gain insights into the experiences, effective practices, and requirements of disaster management organizations and stakeholders regarding the use of SMCS for disaster management purposes. It was a vital part of our *participatory approach*. Specific themes were examined, such as decision-making protocols, sensitivity to vulnerability, reliable information, education, and technical aspects related to SMCS tools and processes used by disaster management organizations. The results were used to develop a first version of the Framework. Via five case studies related to specific hazards – drought, flooding, terrorist attacks, earthquakes and industrial incidents - we identified needs and gaps. The cases were contextualized in four European countries: the Netherlands, Denmark, Germany and Italy.

The second phase of the research was *action-oriented*: the Framework was implemented at case-level through workshops with practitioners (and other relevant stakeholders) to enhance crisis management (both response and preparation) and communication. Practitioners were asked to adopt SMCS in their crisis and communication plans using specific products embedded in the Framework, and also assisted with the development and updates of the products. Some of the most important issues we had to overcome organizing the workshops were:

- It was challenging to organize a workshop for shopkeepers, the general response was that they did not have the time to attend. We needed to adjust our workshop format for this group.
- We struggled to organize the workshop for civilians from the village Limbricht, which is located approximately 7.5 km away from the Chemelot site, citizens stated that they did not perceive any real danger for their town. We ended up organizing this workshop late in the evening on a non-holiday day.
- For those in the Lindenheuvel, directly neighboring the Chemelot site, the civilians had already been suspected to multiple research studies. Organizing the workshop in the Lindenheuvel required some mediation between other active (project) groups in the neighborhoods. This was done in order to prevent overloading the citizens any further.
- There were citizens who did not like hearing that they could contribute to preparedness as they felt that this was the responsibility of the formal authorities and the disaster management organizations. We heard reactions such as: "It is your job to keep us safe! Why does the responsibility have to land on our shoulders?". We were required to carefully navigate communicating safety in a way that did not feel leave the impression we were displacing responsibility.

Each workshop had its own focus group and included members of schools, hospitals, small businesses, shopkeepers. We also organized workshops with civilians in areas close to the Chemelot site (the neighborhoods of Lindenheuvel and Urmond) and one further away from the site (the neighborhood of Limbricht).

The workshops consisted of an informative component provided by professionals from the safety region of South-Limburg and from Sitech Services, a technical service provider. With information on the various roles of the disaster management organizations involved in the region during a chemical disaster, the upscaling of disaster scenarios and the actions that are taken by the disaster management organizations responsible during the various disaster phases.

Aside from an informative part the workshops also included an informal focus group discussion. The primary goal of the workshops was to ensure that citizens were made aware of the risks and that they know what to do in the event of a chemical incident. But perhaps most importantly, during the workshops we emphasized the importance of creating a plan and to practice this plan.

Participatory Action Research in the Dutch Case

During the initial stages of the project, we conducted qualitative and quantitative research into the communication practices of disaster management organizations active in the Safety Region of South-Limburg. In doing so we identified SMCS gaps in the communication practices of several disaster management organizations in the region. As an example, we found that the Safety Region utilizes the SMCS tool Obi4Wan. Obi4Wan is a very useful tool for data analysis and for monitoring social media activity. The information gathered through Obi4Wan is collected to make informed decisions during crises and for education and training purposes within the organization. The Safety Region of South Limburg uses its social media platforms to post about safety related information before and during crises. This information is often quite general, as this information is intended for a very large audience. The Safety Region of South Limburg does not have a tool which they can use to directly target specific communities or groups with risk and crisis communication. Nor is there a direct line of communication between the Safety Region and the community.

The participants in the meetings argued that organizing them around a certain *target group* or stakeholder (see Figure 2) would have the best effect if the participants could relate to a specific topic. In order to shape such target groups we reached out to the various organizations that belonged to a specific group or profession and left it up to the organizations to decide whom they chose to send as representative in what we called *community-based workshops*. To give an idea, for schools directors of several schools, members of school management, representatives of the school district (board) and representatives of the school's BHV team (bedrijfshulpverleening; the emergency response team of the school) represented educational professionals working in the near proximity of Chemelot. They brought in vital information about how schools (the school board, teachers and children) appreciated the industrial risks but also they could bring in information about the social fabric of the school's community that is useful for crisis management organizations.

The community-based workshops included: a discussion about the (formal) responsibilities of the disaster management organizations and governmental parties involved in preserving the safety of those at risk in the event of a chemical incident; an overview of the various actions disaster management organizations and governmental parties conduct in the preparation for and management of chemical incidents; a walkthrough of the safety protocols (what civilians are expected to do); a discussion on how civilians can improve their preparation and how disaster management organizations such as the Safety Region and Sitech can improve their communication in order to more directly target the needs of these groups in the communicative form that works best for them.

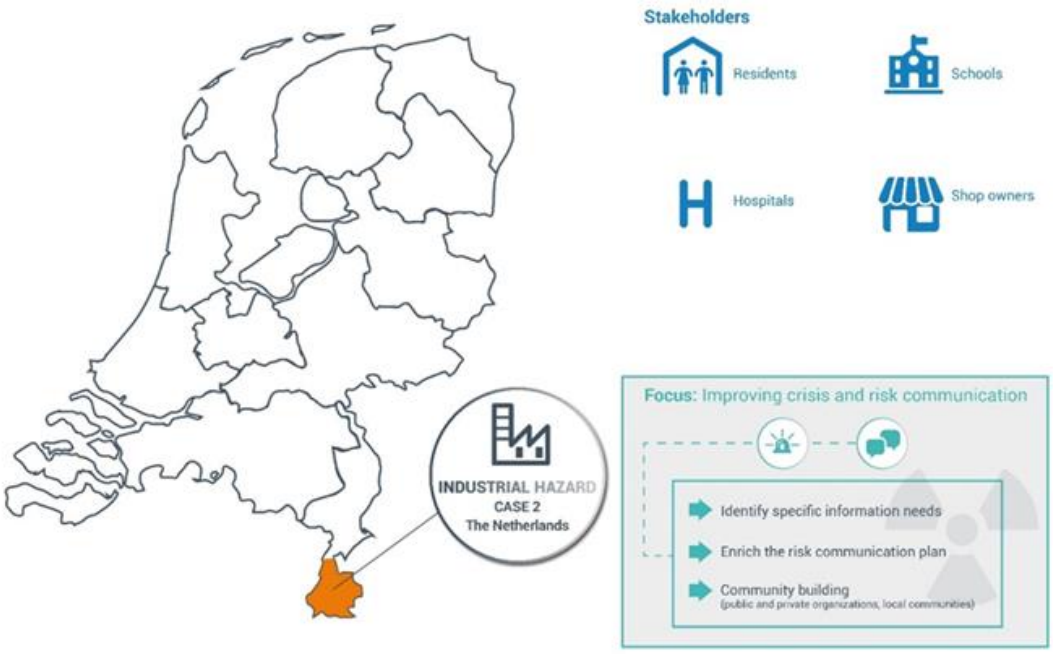

Figure 2. Case Area (from Clark et al., 2022)

Shaping an Ambassadors Network

The first community-based workshop was held in the municipality of Sittard-Geleen, neighboring the industrial site Chemelot, with the target group of *healthcare organizations*. This community-based workshop had eighteen participants, of which seven were healthcare professionals and eleven non-healthcare related professionals with a vested interest. This workshop included directors and healthcare professionals from various hospitals, healthcare practices and care homes from the surrounding municipalities. This workshop was primarily aimed at improving the risk awareness of the healthcare professionals, of making them aware that (chemical) accidents can happen and that proper preparation is therefore crucial, especially when there are so many moving parts. For example, staff on the road (on the way to clients or on the road with ambulances), staff at the homes of clients (care personnel), and staff at hospitals operating on patients (in the ICU).

The second targeted group was *schools* in from the various municipalities neighboring Chemelot (Beek, Stein, Sittard-Geleen). The workshop targeted school directors, school management, and school district representatives. The workshop had a total of thirty attendees, twenty-two were directors and upper management who represented the schools and board of education from the various municipalities. Of the remaining participants, five were organizers from the research team, and three were experts on risk and crisis communication (from the Fire Brigade, Sitech, Chemelot, the local government). This workshop had a similar goal of communicating the risks of a chemical incident, assessing the needs of the participants, providing an overview of the responsibilities of various parties and discussing the importance of creating a disaster plan. School directors, school management, and school district representatives appreciated the open discussion format of the community-based workshop, this provided the opportunity to exchange ideas, concerns and hurdles with us but also with one another.

The involvement of active representatives in the community-based workshops resulted in a network of *ambassadors* that helped us to *co-create* both the content and the implementation of the Framework and contributed to the understanding of the gaps in crisis communication and citizen engagement. The ambassadors can be seen as key figures who acted as 'boundary spanners' (Neal et al., 2022). Because the ambassadors were member of specific target groups *and* engaged in the risk awareness they were able to mobilize different stakeholders, such as healthcare institutions, schools (primary and secondary), and shop owners. The workshops brought together representatives of stakeholder groups that were identified as priority target groups in the initial phase: health institutions, shop owners, and educational institutions. The meetings provided insight into the information needs of various stakeholders, investing in a sustainable community of professionals and residents, and supporting entrepreneurs, companies, and institutions in their preparations for a potential chemical incident.

RESULTS

Throughout the various workshops, we learnt about the vast number of online groups such as neighborhood WhatsApp groups or sport club WhatsApp groups. A single targeted safety message in one of these groups has the potential of being read by hundreds of individuals. The ambassadors advised us on how we can best target the groups or communities they help represent. They could give valuable input to the crisis management professionals present at the workshops on the type of preferred communication format (digital, print, word of mouth), language and information is preferred. In addition, the ambassadors help share safety information about the chemical industry through their networks and help expand our existing network.

During the workshops the participants indicated that building and maintaining relationships with stakeholders is crucial, not only during emergencies (response phase) but also in 'normal' circumstances (preparation phase). This seems to be an obvious result, but it was striking how difficult it was for the different stakeholder to find each other despite the good intentions. Social media platforms were seen as a promising tool for making new connections, but at the same time their rapid changing popularity makes it difficult for the users to fully utilize their potential and to integrate them in the first responders' crisis communication strategies.

The community-based workshops' participants agreed that understanding *how* information is shared and received by citizens and professionals is key and depends on the characteristics of a specific platform. Not knowing how to use them and how to make sense of the data creates confusion. For example, various publicly accessible social media sources are used by the Safety Region Limburg South to gauge information needs and sentiments, but there are doubts about how representative these sources are of how the inhabitants of the municipalities actually feel about hazards and risks. Communication between citizens increasingly occurs in non-public spaces, such as neighborhood apps or family groups, which can make it challenging to assess information needs and sentiment towards organizations.

The discussions revealed that adequate and precise crisis communication is challenging in case of a chemical spill. For example, recalling people back inside or instructing them to stay indoors during a chemical incident was identified as an area that needs more attention. The workshop participants emphasized the need for better communication systems and guidelines within healthcare organizations to ensure that critical information is disseminated effectively.

Finally, we found a need among the first responders to clarify the concept of *crowdsourcing*, as they struggle with finding the right tools to mobilize citizens. The lack of internal guidelines, organizational routines but also laws and regulations regarding social media and crowdsourcing during crises and disasters were seen as serious constraints.

Zooming in: Community-Based Workshops with Healthcare and Educational Professionals

The community-based workshops we organized with and for *healthcare professionals* identified several key conclusions regarding the preparedness of healthcare organizations for chemical incidents. Participants highlighted the need for more emphasis on self-reliance and preparedness of healthcare organizations and their staff, indicating a gap in current practices. They also expressed surprise that they were supposed to practice and prepare for chemical incidents, and they indicated the need for greater awareness and room for training to ensure that healthcare professionals are adequately prepared for such events.

The healthcare professionals appreciated being able to communicate their reservations and needs directly during the workshop. They pointed out that they would like more direct and targeted communication between disaster management organizations and the communication teams of the respective hospitals and healthcare practices. For example, questions raised by the workshop's participants were: "If we need to close the doors and windows, are we allowed to let our staff inside?", "If we turn of the ventilation or IC units won't function anymore.", "A lot of our care home workers are often on the road with the bike or car, how do we preserve their safety?" and – a returning question - "How do we make sure people stay indoors during an incident?"

They hoped for more targeted information during crises but also assistance in creating disaster plans for their own organizations. The workshop participants emphasized the need for incident training exercises for healthcare organizations and suggested that existing structures, such as hospital ventilation and organizational guidelines, should be re-evaluated and adapted for chemical incidents. These findings suggest that ongoing preparedness efforts are needed to ensure the safety of healthcare professionals and patients in the event of a chemical incident and that a comprehensive approach is required to address the identified gaps in current practices.

The community-based workshops with *educational professionals* identified several key conclusions related to the preparedness of educational systems for chemical incidents, highlighting the need for accessible and functional

windows, doors, grilles, and ventilation systems that can be quickly and easily closed off in the event of an incident. The workshop also recommended that schools have a pre-prepared (digital) message for parents, teachers, and children, as well as a meter card for chemical incidents and a well-coordinated communication plan. Additionally, the workshop emphasized the need for schools to establish a clearance program and practice different scenarios to ensure they are well-prepared to respond to any potential incidents.

Some of the school directors advised the crisis management professionals to practice exercises with their schools and others requested assistance with their disaster plans. The schools commented that they would appreciate more direct communication with the Safety Region in particular, they felt it would also be beneficial if there was a way to improve the communication between the schools themselves. It can be confusing for parents with children that go to different schools when not every school reacts the same way to incidents. For example, certain schools letting the children go while other schools keep the children inside for safety reasons. Examples of the kind of questions and issues for discussions during these meetings were: "What do we do if there are parents at the door, but we are required to keep students indoors for their safety?" and "We had an incident a while back where students from a neighboring district were allowed to go home, but we kept the students indoors. What do we tell the angry parents?"

The community-based workshops (guided by the implementation of the Framework) proved to be effective in contributing to the development of effective tools and resources for enhancing preparedness and response capabilities in the event of a chemical incident. By sharing practical perspectives, they contributed to the development of a more comprehensive and inclusive framework for engaging citizens in various crisis contexts.

DISCUSSION AND CONCLUSION

In this paper, we argued for the need to develop a coherent set of tools and guidelines – an integrated Framework - to successfully implement, utilize and further develop social media and crowdsourcing in crisis and disaster management. SMCS tools were seen as promising, but only if they serve the needs of local communities and under the condition that they could be easily integrated in the first responders organizational routines. And while there is a lot of knowledge on both the benefits and the challenges of SMCS in crisis context, both academics and practitioners struggle to integrate the knowledge coherently and consistently. By providing a framework based on co-creation activities, we believe the use of SMCS can be more successful. Next, we introduced the Framework developed in the European project LINKS and its implementation in a case study on industrial, chemical hazards.

The case study illustrates how the Framework helped to identify key components for effective SMCS integration in crisis management. However, continuous iteration is necessary for a successful use and integration of SMCS in crisis management and communication practices. The iterative process and the participatory and action-oriented case study approach allowed refinement to address emerging challenges and specific needs. The community-based workshops served as a means to apply and refine SMCS integration. Local community ambassadors networks were vital to developing effective tools and resources for enhancing preparedness and response capabilities in specific contexts.

The case has also shown how the Framework can contribute to organizational change by enhancing preparedness and response capabilities for chemical incidents in healthcare and educational institutions. By integrating the feedback from community-based workshops professional first response organizations made a start with the development of effective practices for the integration of SMCS. Perhaps the most important lesson when it come sot the successful use of social media for crisis and risk communication is that it should be combined with or contain concrete ' action perspectives' and that face-to-face meetings with those who are supposed to follow up the messages are crucial.

Finally, the ambassador program is an example of how crisis management organizations can be actively engaged with a diverse range of community organizations, including educational institutions, healthcare institutions, and neighborhood support groups to enhance preparedness and response capabilities for chemical incidents in municipality neighboring a chemical hazardous site.

A Promising Outlook

The Framework's focus on local implementation has allowed for a tailored approach that considers local diversity, vulnerability, accessibility, and institutional learning processes, enhancing disaster resilience and coordination between authorities and citizens. The co-created nature of the Framework proposed in the paper has contributed to its legitimacy. Looking to the future, the Framework can contribute to development of organizational and institutional routines based on the experiences of both professional first responders and citizens. By sharing practical perspectives, it will continue to help shape the development of more comprehensive and effective

resources for engaging citizens and improving the use of SMCS, beyond the case of Chemelot.

We believe that using such integrative frameworks for SMCS based on co—creation approaches will result in better communication practices in disaster management and ultimately contributing to a safer and more resilient society.

ACKNOWLEDGMENTS

This work was supported by the LINKS Project that has received funding from the EU Horizon 2020 Research and Innovation Programme under Grant Agreement No. 883490. We would like to thank the project's partners Safety Region of South Limburg, Sitech Services and Chemelot for providing access and for co-organizing the workshops.

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