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Preface

This handbook introduces the results of the BuildERS research project. The overall aim of the BuildERS project was to improve resilience especially within European societies. Understanding societal resilience as dependent on individual capacities to deal with extreme events, the project sought to empower those who are currently most vulnerable to increase their potential to (re)act and contribute to crisis management. The BuildERS project was carried out during 2019–2022. The project was funded by the European Union's H2020 research and innovation programme.

We have had the great privilege to discuss and collaborate with a large number of different stakeholders during the project—experts and target groups, academia and policy makers, vulnerable people and first responders. Once the COVID-19 pandemic started, the BuildERS project quickly adjusted and carried out these activities mostly virtually. Certainly, we would have rather opted to meet our stakeholders in person on various occasions and events, however, the feedback we collected was of immense value regardless of the circumstances. We also warmly thank the members of the Advisory Board for their valuable advice and support during the project. We would particularly like to thank all the contributors, experts in their own fields, who took part in the co-creation activities sharing their experiences and knowledge and making a significant impact on the findings of the project.

This handbook is a result of the fruitful collaboration between the BuildERS project consortium partners. We would like to thank all the authors for the stimulating conversations and contributions to the writing work.

April 2022

Authors

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List of symbols

5G	Fifth-generation technology standard for broadband cellular networks
AI	Artificial intelligence
BASARNAS	Indonesian National SAR (search and rescue) Agency
BNPB	Indonesian National Disaster Management Agency
BuildERS	Building European Communities' Resilience and Social Capital
CEPOL	European Union Agency for Law Enforcement Training
COVID-19	Coronavirus disease 2019
CPS	Cyber-physical system
D	Deliverable (e.g., D1.2)
DG ECHO	The Directorate-General for European Civil Protection and Humanitarian Aid Operations
DRS	Disaster-resilient societies
eTwinning	Community for schools in Europe
EU	European Union
FIS	Fuzzy Inference System
IoT	Internet of Things
LCC	Life-cycle cost
LEEd	e-learning platform for law enforcement education
LINKS	Strengthening links between technologies and society for European disaster resilience
MPD	Mobile positioning data
NGO	Non-governmental organization

NSS	National Support Services
PE	Protective equipment
PESTEL	Political, economic, socio-cultural, technological, legal, and environmental (factors)
RESILOC	Resilient Europe and Societies by Innovating Local Communities
SDCCP	Service Design Canvas for Community Policing
SWOT	Strengths, weaknesses, opportunities, and threats
T&T	Technologies and tools
UN	United Nations
UNISDR	United Nations for Disaster Risk Reduction
WP	Work Package

1. Introduction

Jaana Keränen, VTT Technical Research Centre of Finland

1.1 The fundamental aim of the BuildERS project

The Sendai Framework (UN 2015) for Disaster Reduction 2015-2030 points out that global evidence indicates that in all countries, the exposure of people and assets to disasters has increased faster than attempts to reduce vulnerability. A high share of human and material loss occurs due to frequent small-scale disasters and large-scale events that have crossed the news threshold. These smaller-scale adversities particularly affect communities and households and cause hidden costs that are not taken into account.

The Sendai Framework emphasizes the commitment of society as a whole to the most vulnerable people, while taking into account contextual and cultural differences. It also calls for a more explicit focus on people, their health and livelihoods, and the local level, since individuals and local communities have their own capabilities, networks, methods, tools and means to absorb and recover. Thus, the 'capital' that is available at the root-level deserves to be recognised and incorporated in the policies and strategies for disaster risk reduction and enhancing of resilience.

When a disaster strikes, it is not always clear, who really are those in the most vulnerable position: the elderly or those with mobility impairment, or even children who do not comprehend the severity of the disaster? Is it people without local language skills such as tourists or immigrants, impoverished people who cannot afford moving away or protecting themselves, or just people who are not willing to leave their property under threat? Some of those in the most vulnerable situations are the ones who need attention from the voluntary organisations, such as the socially marginalised, people with substance addictions, or people without any social networks.

To improve the overall resilience of people, communities and thereby the whole of society, the BuildERS project focused on the most vulnerable individuals, people and communities. Strengthening the resilience of people who have a very high risk of becoming vulnerable in disasters will increase the understanding of what comprises societal resilience. Understanding societal resilience as being dependent on the capacity to deal with extreme events, BuildERS sought to empower those who

are currently most vulnerable. Their potential to act and contribute to crisis management needs to be strengthened in various ways.

The BuildERS project scrutinized existing approaches, strategies, technologies and tools to measure and reduce vulnerability in the light of the social diversity of European societies. Based on the assumption that risk awareness, social capital (social relations and trust networks) and preparedness are core aspects influencing vulnerability, the aim in the BuildERS project was to find out more about who the most vulnerable are in European society and for which reasons. Our fundamental aim was to increase the resilience of European communities against crisis through the co-creation of innovations focusing on how to improve the situation and increase capacities so that they can take part in the resilience building of European societies. The common vision of the BuildERS project including areas of assessing, understanding and recommending vulnerability is illustrated in Figure 1.

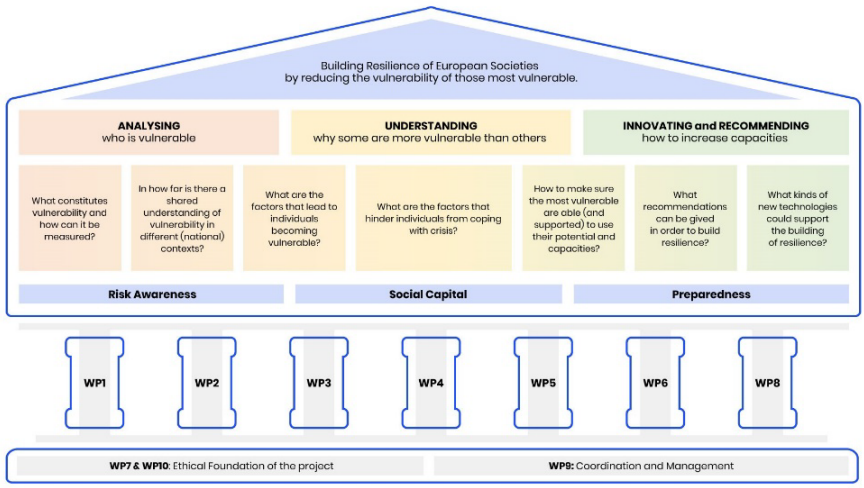

Figure 1. The BuildERS consistency model

The approach of the BuildERS project was reflected in the sequential structure of the WPs. WP1 created a theoretical basis on the constitution of vulnerability. WP2 complemented this theoretical work with an empirical survey on the understanding of vulnerability and resilience in different national European disaster and crisis management systems. Building on this, WP3 examined the living situation and self-perception of vulnerability of a heterogeneous group of Salvation Army service users who were connected by their relative economic deprivation. While most empirical studies have ascribed or observed vulnerability, WP3 drew on the expertise and perspectives of people who are commonly seen as vulnerable. WP4 analysed who becomes (more or less) vulnerable in different contexts and when and why. WP3 and WP4 not only validated the findings (and especially cross-country differences and similarities) and the theoretical framework of WP1 and WP2, they identified

shortcomings in the current European crisis management systems, which allowed innovations and recommendations to be formulated in WP6 and WP5. Thus, the BuildERS model operationalized theoretical and scientific work as co-creation and innovation streams and organizational practices.

This handbook seeks to reach audiences including academia, civil society organizations, citizen groups, official first responders, NGOs, and policy and decision makers at the European, national and local level. The BuildERS project offers alternative approaches, strategies, technologies, and tools to measure and reduce vulnerability and gives recommendations on how to achieve them. These will engage different actors from all levels of European disaster management. Resilience policy recommendations are targeted for decision makers and policymaking officials at all levels who are responsible for the strategic planning and drafting of laws. Practical innovations, such as process guidelines and tools, are primarily targeted for the first responders (civil society organizations, civil protection authorities, fire and rescue services, law enforcement, health care, social services, and psychological support in crisis) and other agencies responsible for crisis management. In addition, these innovations benefit their strategic partners such as non-profit and civil society organizations who are active in inclusive and participatory resilience building. The scientific contributions and innovations of the project are targeted especially at the research community, scholars and students.

1.2 BuildERS vocabulary

The BuildERS approach seeks to understand how to build resilience through greater attention and understanding to the dynamics of risk awareness, social capital, and vulnerability. To better understand this dynamic and connections, BuildERS has made following definitions for the key concepts:

Resilience—Processes of proactive and/or reactive patterned adjustment and adaptation and change enacted in everyday life, but, in particular, in the face of risks, crises and disasters.

Risk awareness—Collective (in groups and communities) acknowledgment about a risk and potential risk preventing and mitigating actions, fostered by risk communication.

Social capital—Networks, norms, values and trust that entities (individuals, groups, society) have available and which may offer resources for mutual advantage and support and for facilitating coordination and cooperation in case of crisis and disasters.

Vulnerability—Dynamic characteristic of entities (individuals, groups, society) of being susceptible to harm or loss, which manifests as situational inability (or weakness) to access adequate resources and means of protection to anticipate, cope with, recover and learn from the impact of natural or man-made hazards.

1.3 The structure of the handbook

The handbook is structured so that the first part of the handbook introduces the scientific results of the BuildERS project and the rest of the handbook presents the results applied by the project.

Chapter 2 deeply examines the nature of resilience and vulnerability in disaster management and introduces these two BuildERS key concepts. It also emphasises the importance of ethical considerations in the research of vulnerability. Chapter 3 provides more perspectives on vulnerability and resilience based on past crises, and presents the results of the survey conducted on the clients of care organisations during the COVID-19 pandemic. Chapter 4 describes tools and guidance that have been developed through co-creation activities with many stakeholders to enhance resilience in disasters. Chapter 5 introduces technological solutions that can be used to support and build resilience, taking into account data management and ethical issues. Finally, Chapter 6 presents the closing words of the project.

2. Resilience and vulnerability

2.1 Understanding societal resilience

Claudia Morsut and Christian Kuran, University of Stavanger

Societal resilience has become a key concept to describe a wide range of efforts to cope with crises and disasters. Societal resilience heavily depends on how citizens behave individually and collectively and how international organisations and states design and implement policies for mitigating risks, preparing for, reacting to, overcoming and learning from crises and disasters. Thus, societal resilience should be a shared achievement between the ability of individuals to adapt to crises and disasters and bounce back when a disaster strikes and the ability of institutions to absorb external shocks.

Resilience building is not an easy endeavour: besides promoting technical and administrative solutions, governments, humanitarian international/national/local organisations, and risk and crisis/disaster managers need first and foremost to empower individuals, groups, and local communities through meaningful participation in resilience building. This empowerment is realised through a deep and clear understanding of the socio-economic and cultural context within which individuals live, in addition to their capacities, risk awareness, social capital and vulnerabilities. In addition, we live in such interconnected and intertwined systems that changes in one system or in parts of it can lead to new vulnerabilities and unknown risks, all exposing societies to unexpected challenges that, in turn, affect resilience. The so-far two years of the COVID-19 pandemic is a striking example in this regard. Nowadays, the level of exposure to technological failures, information and communication technology dependencies, rapid changeovers and readjustments in public and private industries, climate change consequences, warfare, and state failures need to be targeted properly by resilience building by taking into account that individuals are usually embedded in families, families in organisations and communities, and communities in societies. Interventions targeted at one of these levels may influence the other levels. Resilience building needs to consider the adaption of these interconnected systems and the great potential carried by individuals to adapt in crises and disasters when provided with the proper social and material resources to do so (Southwick et al., 2014).

If a society is not able or only partially able to understand and take the proper measures to address vulnerabilities, societal resilience cannot be achieved. Investing in all members of a society according to their skills and capacities: only this will make resilience a characteristic for the whole of the society. In particular, all members of a society present elements of resilience and vulnerability, which are not self-excluding, but intimately intertwined. Ultimately, we need to take into account both resilience and vulnerability to pre-figure levels of exposure to hazards and risks and consider the kinds of abilities individuals possess to be able to cope with crises and disasters.

The model below (Figure 2) is the BuildERS' theoretical framework which highlights the interconnectedness of resilience and vulnerability, two of the central research concepts of the project together with social capital and risk awareness.

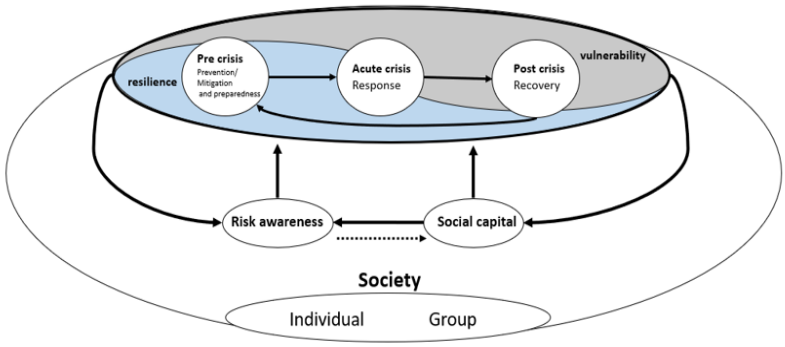

Figure 2. The BuildERS' model (Morsut et al. 2021: 7).

In BuildERS we promote the following understanding of societal resilience:

Processes of proactive and/or reactive patterned adjustment and adaptation and change enacted in everyday life, but, in particular, in the face of risks, crises and disasters.

More information: Morsut, C. et al. 2020. D1.2 Final report of the unified theoretical framework on the concepts of risk awareness, social, capital, vulnerability, resilience and their interdependencies. BuildERS Report.

Morsut, C. et al. (2021). Linking resilience, vulnerability, social capital and risk awareness for crisis and disaster research. Journal of Contingencies and Crisis Management DOI: 10.1111/1468-5973.12375.

2.2 Understanding vulnerability: who is vulnerable and how to mitigate vulnerability?

Kati Orru, Sten Hansson and Sten Torpan, University of Tartu

In the BuildERS project, the core question lies in who are vulnerable and what role different institutional support structures play in mitigating vulnerability. In disaster management, the social side of vulnerability is often seen as an intrinsic and static characteristic of an individual or a group, such as people with disabilities, the elderly,

or those living in poverty (see Orru et al., 2021 for a European overview; also BuildERS report D2.2). Such an approach tends to neglect the huge diversity within these 'vulnerable groups', and the fact that those who are often not considered vulnerable might become vulnerable due to certain situations they are in.

It is the dynamic interplay of different disadvantages that leads to a person being more vulnerable (United Nations, 2015). Vulnerability can be better understood as a result of interdependent and intersectional factors that produce socially differentiated impacts (Kuran et al., 2020, see also BuildERS D1.3). In particular, the focus should be on the interactions between individual, social-structural, and situational factors that may change over time (Gabel, 2019; Hansson et al., 2020).

Based on the work in the BuildERS project, Orru et al. (2021) propose a novel conceptualisation of vulnerability that aims to retain sensitivity to the situation-specific and spatial dynamics of vulnerability. The framework suggests that for a more systematic understanding (assessment and response), the factors of social vulnerability could be categorised across two dimensions:

(1) primarily stemming from human agency and capacities or the functionality of the surrounding technological and political structures, and

(2) a function of the availability, accessibility and functionality of social (material, psycho-social and informational) support through private relations and/or through societal provision (institutional care).

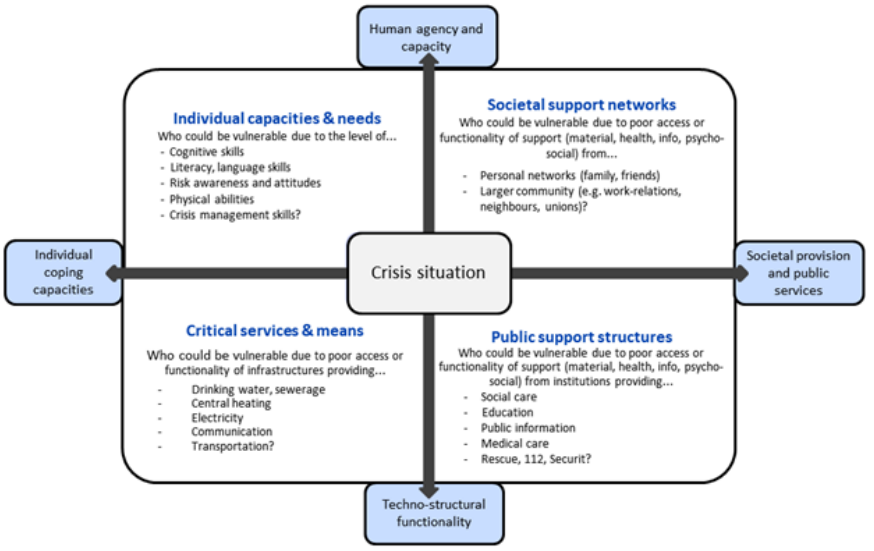

Figure 3. Conceptual dimensions of 'social vulnerability' in disaster management (Orru et al., 2021).

In a crisis situation, these two dimensions of vulnerability intersect, and their impact is amplified or attenuated by the situational characteristics, such as an individual's proximity to a hazardous area (Orru et al., 2021). The model (Figure 3) suggests that four spectrums of vulnerability factors—individual capacities, societal support networks, critical infrastructure, and public support services—need to be considered for a comprehensive overview of the possible sources of vulnerability which may be critical in helping communities and policy makers to better prepare for and respond to extreme events. A practical application sensitive to these measures of social vulnerability in the context of imagining and assessing future risks is discussed in Chapter 4.2. of this handbook.

2.2.1 Communication-related vulnerability to disasters

Based on the findings of the BuildERS project, Hansson et al. (2020) propose an original framework for identifying the factors of vulnerability related to communication, that is, how people access, understand, and react to information about hazards (Table 1). These factors could be individual (e.g. perceptual impairment), social-structural (e.g. lack of support and information from crisis management authorities), and situation-specific complications, such as the proliferation of misinformation.

Table 1. Factors of communication-related vulnerability to disasters (examples from Hansson et al. 2020)

	Individual	Social-structural	Situational
Accessing (the capacity to send and receive messages)	No access due to functional impairments (e.g. poor hearing or eyesight) No resources to access media	Poor communication infrastructure (e.g. no radio reception or internet access)	Broken communication infrastructure (e.g. cell towers destroyed in fire)
Understanding (the capacity to adequately interpret messages)	Inability to read Limited language skills	Information provided is too complex, confusing	Exposure to false or contradictory information
Reacting (the capacity to take protective action)	Lack of skills for self-protection Lack of resources to stock up with supplies	Lack of support for disadvantaged groups Lack of preparedness measures	Type and magnitude of hazard affect the degree of personal control over one's situation

To exemplify the situation-specific communication-related complications during a crisis, we developed a typology of harmful information that threatened people's lives, health, or property during the onset of the COVID-19 pandemic (Hansson et al., 2021). We distinguished six types of harmful information:

1. Representation of recommended or mandatory protective measures as being harmful or unnecessary
2. Calls to use harmful 'remedies'
3. Misinformation about the mechanism of the spread of the virus
4. Misguided denial or downplaying of danger
5. Exploitation of confusion and fear for fraudulent purposes (scams)
6. Harassment of alleged perpetrators

In crises such as pandemics, vulnerability is not increased just by exposure to health-related misinformation: people may also suffer from fraud and harassment (Hansson et al., 2021). A thorough understanding of the ways in which people may become more vulnerable because of potentially harmful information or communicative behavior is vital for all risk and crisis management authorities.

2.2.2 How do authorities address people's crisis vulnerabilities?

In the BuildERS project, we compiled an overview of how disaster vulnerability is understood and addressed in Estonia, Germany, Italy, Belgium, Hungary, Sweden, Norway, and Finland (Orru et al., 2021). The social aspects of crisis vulnerability are systematically addressed in only a few countries and are dominated by an interpretation of vulnerability based on social groups (e.g. 65+, with disabilities). The study suggests that a society-wide discussion should be promoted on who is considered vulnerable, for what reasons, and who should address the vulnerability. Furthermore, vulnerability reduction strategies should not place the responsibility on the individual, ignoring those structural challenges that make some more vulnerable to the consequences of emergencies than others (Orru et al., 2021).

We also scrutinised the institutional approaches to reducing vulnerability to false information during crises in these countries (Torpan et al., 2021). There were no uniform practices for tackling false information in the context of crises, and only in some countries (Sweden, Finland, Norway, Estonia) were there official guidelines for dealing with misinformation. We suggest that crisis management institutions should run information literacy campaigns, systematically counter false information, and enhance their own ability to provide trustworthy and timely information (Torpan et al., 2021).

More information: BuildERS reports D2.2, D2.3, D2.4.

Hansson, S., Orru, K., Siibak, A., Bäck, A., Krüger, M., Gabel, F., Morsut, C. (2020). Communication-related vulnerability to disasters: A heuristic framework. International Journal of Disaster Risk Reduction, 51, 101931. DOI: 10.1016/j.ijdrr.2020.101931.

Hansson, S., Orru, K., Torpan, S., Bäck, A., Kazemekaityte, A., Meyer, S. F., Ludvigsen, J., Savadori, L., Galvagni, A., Pigrée, A. (2021). COVID-19 information disorder: six types of harmful information during the pandemic in Europe. Journal of Risk Research, 24:3-4, 380-393, DOI: 10.1080/13669877.2020.1871058.

Orru, K. Hansson, S., Gabel, F., Tammpuu, P., Krüger, M., Savadori, L., Meyer, S. F., Torpan, S., Jukarainen, P., Schieffelers, A., Lovasz, G., Rhinard, M. (2021). Approaches to 'vulnerability' in eight European disaster management systems. Disasters, 46 (3). DOI: 10.1111/disa.12481.

Torpan, S., Hansson, S., Rhinard, M., Kazemekaityte, A., Jukarainen, P., Meyer, S. F., Schieffelers, A., Lovasz, G., Orru, K. (2021). Handling false information in emergency management: A cross-national comparative study of European practices. International Journal of Disaster Risk Reduction, 57, 102151. DOI: 10.1016/j.ijdrr.2021.102151

2.3 Ethical considerations in research of vulnerability in disaster resilience

Friedrich Gabel, University of Tübingen

The EU-Horizon 2020 programme on research and innovation aims at developing technologies and strategies that will improve the quality of life of citizens of the EU and beyond. To achieve this, different disciplines are encouraged to work together to combine their perspectives and expertise to develop technologies. One of these disciplinary expertise and perspectives is ethics (European Parliament, 2012), which is defined as the reflection on moral judgements in academia (Pieper, 2007: 60). As research and innovation always aim at making the life of the whole or at least of parts of society better, every technology development entails a more or less explicitly formulated answer to the question "Which society/world do we want to live in?" (Ammicht Quinn, 2014: 28). The involvement of ethics into research and development activities aims at a critical reflection and discussion about the values that are inscribed in technology. By doing this, potential issues or unwanted consequences should be identified during the actual research activities, rather than after their implementation.

2.3.1 Ethics in the research on vulnerability

Disasters are by definition major disruptions of everyday life (UNISDR, 2017). Although they threaten life and property of human beings unwantedly and undeservedly by accident, neither their genesis nor the distribution of their consequences are random but rooted in social action (Zack, 2011: 7). This social side of disasters, the vulnerability or susceptibility of a society/group/person or settlement/infrastructure/building were a central part of the BuildERS project research and referred to the specific physical, mental, emotional, socio-economical, power-political, socio-

contextual coping capacities (or parts of this list) of entities in the case of disasters (Gabel/Krüger, 2021; Wisner et al., 2004: 7). By investigating vulnerabilities within society as well as different concepts of resilience to reduce vulnerabilities, the research activities to improve disaster management were linked to a variety of ethical and social topics (Geale, 2012: 455; Shuster, 2014).

Against this backdrop, the BuildERS project has become part of an ongoing academic discussion about the way in which we understand vulnerability and the measures that will come with it to reduce vulnerability. For the BuildERS project this encompassed three aspects. First, a broader debate of the subject of vulnerability: "Who is vulnerable?" Second, a better understanding of the reasons which render a person vulnerable: "Why are some people more vulnerable than others?" Third, the development of strategies to reduce vulnerabilities: "How can individual capacities be increased?"

As all three aspects are linked to ethical questions, especially on social justice or the just distribution of security and measures of disaster risk reduction in society, the BuildERS consortium involved ethical considerations at all stages of the project. With regard to the question of **"Who is vulnerable?"** all studies on the one hand aimed at representing those who are usually overlooked in disaster management. On the other hand, they recognised individual living situations including those factors that allow them to cope with disasters as well as those which increase their vulnerability. From a practical point of view, the BuildERS project developed tools and innovations to ensure this visibility of complex living situations beyond the project itself (see chapters 4.2 and 5.3). Further, the question of **"Why are some people more vulnerable than others?"** was scrutinized as an issue of justice. It focuses on the (un)equal distribution of (a) the ability to benefit from societal structures of disaster preparedness as well as (b) the ability to benefit from support structures in times of disasters. In this vein, not only did the BuildERS project promote a complex and intersectional understanding of vulnerability (Kuran et al. 2020) that sees individuals not as part of a single homogeneous group (e.g. the elderly, poor), but as multidimensional individuals being embedded in and confronted with potentially limiting structures. On a practical level, the BuildERS project aimed to make existing structural issues more visible. Finally, in terms of addressing **"How to increase individual capacities?"** the project aimed for policies and innovations that reduce these challenging sometimes even discriminating structures and power relations.

To achieve this and allow for a comprehensive approach to value-related questions, ethics was involved in a threefold way in the BuildERS project.

2.3.2 Threefold ethics approach in the BuildERS project

First, ethical reflections were implemented through ensuring **standards of ethically good empirical research**. For the BuildERS project a key component was the development of information sheets and data protection procedures. These should not only allow for a voluntary and well-informed choice for participation but should also ensure that personal data was only collected if truly necessary for the research activities and that data storage provided a restricted and safe environment for the

given information. Further it encompassed the consideration of precaution measures for the involvement of participants in vulnerable situations, who were likely to suffer from re-traumatisation or exploitation due to the specific situations they are in.

Second **ethical monitoring** of all tasks and activities performed took place over the whole project lifetime. This process was structured as follows: before the actual start of a work package, all research tasks and planned activities were screened on potential ethical issues and/or ethically relevant topics which were felt to be important for discussion in the course of the project. This was done against the backdrop of six value related dimensions, which can be described as key dimensions for the planned BuildERS innovations: (a) justice and participation, (b) responsibility and accountability, (c) freedom of choice and autonomy, (d) trust and transparency, (e) non-maleficence and beneficence as well as (f) privacy and data protection. If this screening suggested an ethically relevant topic, it was advised to the responsible partners to start a discussion on how to deal with this question. Subsequently, all partners had the chance to once again comment or adjust the results of the screening to provide a sound as well as shared basis for the upcoming execution of research activities. Finally, the ethics partner provided an ethics counselling during the respective tasks and in sum throughout the whole project lifetime to allow for the most appropriate solutions for identified issues as well as meaningful decisions on ethically relevant topics.

Thirdly and finally, in the BuildERS project ethics was involved in the research and innovation process in a content-wise way by **raising and discussing specific ethical questions**. This ethical reflection took place around the concepts of acceptability and acceptance of social and technical innovations developed within the project as well as the implications these might have. While acceptance, refers to questions such as: “Is something (morally) accepted by its users?” or “Do users use the technology or does it conflict with their beliefs?”, acceptability refers to the desirability of technologies and innovations and whether something ought to be accepted. For example, this could involve what the limitations should be of a technology or innovation for collecting, storing or managing information of individual vulnerabilities. Such questions were raised for instance in the co-creation process in the form of a living questionnaire which raised reflective questions on specific innovations or recommendations which were developed by the BuildERS consortium.

Based on this threefold approach of involving ethics in the BuildERS project, a complex and ongoing discussion on ethics took place throughout the whole research and innovation process. As an integrated part of the different research activities, ethical considerations inspired and accompanied every step of developing appropriate technological and social innovations.

2.3.3 Key findings and policy recommendations

Less than a result itself, the involvement of ethics in all activities of the BuildERS project inspired the development and design of every technological and social innovation with regard to its desirability. Especially in the context of co-design and the

formulation of the BuildERS project recommendations, ethics played a core role in the way of raising topics and questions to be considered with regard to the implementation. In this way, it should be ensured that the results developed by the BuildERS project achieve the aim of a more just distribution of vulnerabilities and coping capacities between all people living in the European Union. Thereby, the risk of negative side-effects should be reduced by reflecting on cascading effects in advance.

Nevertheless, the ethics procedure itself—already during the project lifetime—became inspiring to other projects of the DRS01 cluster and provided guidance for the RESILOC and LINKS projects on how to integrate ethics throughout the whole research and development process. In this vein, the threefold ethics approach offers a tested structure on how to address value-related questions not only as an ethics of research but also research on ethics.

More information: BuildERS report D6.6: BuildERS Guidelines for Ethical Assurance in Inclusive RDI-projects.

3. Lessons identified by research outputs

3.1 Satisfaction with temporary housing and the impact on social costs

Lucia Savadori and Luigi Mittone, University of Trento

How well we manage a crisis depends on how well we are prepared to deal with it. With this in mind, in the BuildERS project we built on past experiences to improve preparedness for future crises. Here we summarize the key results obtained in a study that focuses on the post-crisis phase, examining a past crisis to extract valuable suggestions for improving this particular phase of the crisis management cycle.

Research and study of past crises help understand what aspects of the preparedness plan did not work or worked less effectively. Understanding these flaws allows society to improve by making concrete contributions to our crisis management plans so that we can be better prepared for the next emergency. As any crisis management expert knows, the first step is to identify risks, that is, to identify possible sources of danger and quantify them in terms of possibility and severity. In the BuildERS project, risk identification translated into identifying human and social vulnerabilities in given crisis contexts.

As part of the BuildERS project, the past crisis investigated was the crisis produced by a **natural disaster** (earthquake). The phase of crisis management investigated was the **post-crisis stage**, particularly the evacuation from one's home and the subsequent stay in temporary housing solutions after the disaster. In particular, three Italian disasters were investigated: the 2009 Abruzzo (L'Aquila) earthquake, the 2012 Emilia earthquake, and the 2016 Central Italy earthquake.

The analysis conducted within the BuildERS project revealed a situation of considerable psychological suffering (i.e. low wellbeing) of the survivors involved in the post-crisis stage of the crisis. Psychological suffering is an indication of **vulnerability** that should not be underestimated. The WHO definition (WHO, 2006), for example, incorporates wellbeing among the main factors determining the concept of health (Jadad & O'grady, 2008; Lancet, 2009). Therefore, it is fair to say that psychological wellbeing is an integral part of physical wellbeing and that dissatisfaction is a social cost.

BuildERS project researchers examined the discomfort of people housed in temporary housing after a disaster to understand the causes of this discomfort and draw valuable insights for future crisis management. In line with the BuildERS project aims, the vulnerability in this context was examined to understand how the most vulnerable of those exposed to disasters and threats understand the risks, prepare for them and behave individually and collectively.

The evidence collected showed that:

- Displaced people are a **new vulnerable group** that did not exist before the disaster; this group is created as a result of the disaster itself.
- Displaced people show significant deterioration on all measured indicators of vulnerability (quality of life, perceived health, and symptoms of post-traumatic stress disorder) beyond that experienced by individuals who experienced the disaster but were not displaced from their homes.

The leading **causes of vulnerability** were of three types: structural, psychosocial, and individual.

- Among the **structural variables**, the specific type of earthquake had a significant impact (wellbeing was significantly lower in the 2016 Central Italy earthquake than in the 2012 Emilia earthquake). Additionally, the **perceived quality** of the temporary **housing solution** was strongly determinant in impacting low wellbeing: those who perceived a higher quality of temporary housing reported less decline in their quality of life as a consequence of the displacement than those who perceived a lower quality of the temporary housing. No specific quality of the housing was decisive (e.g. light, privacy, thermal insulation, etc.) but rather, the perception of low overall comfort.
- Among the **psychosocial variables**, a significant effect was played by the degree of place attachment and the extent of individual resilience. A higher **place attachment** before the disaster was correlated with a less decreased quality of life during displacement, especially in the 2009 Aquila earthquake and the 2016 Central Italy earthquake, but not in the 2012 Emilia earthquake. Likewise, a higher **individual resilience capability** of bouncing back after crises reduced the negative impact of displacement on wellbeing.
- Among the **individual variables**, only the participants' age was significantly associated with a change in wellbeing during displacement in temporary housing, although the effect depended on the type of earthquake. For example, in the Abruzzo earthquake (2009 L'Aquila), older people suffered more than younger people, while in the 2016 Central Italy earthquake, younger people suffered more than older ones. In contrast, in the 2012 Emilia earthquake, there was no difference between age groups.

The main directions for crisis management that emerged are as follows:

- Recognize that displaced people are particularly **vulnerable** and that their management should be planned in advance and included in post-crisis emergency management plans.
- Within the crisis management plan, more emphasis should be placed on **the post-crisis phase**, especially in a long-term view: a crisis does

not end when people are rescued but when the wellbeing of those people is restored.
- Increase the **quality of temporary housing** in terms of general comfort, understood as the restoration (during the displacement period) of those relationships with the environment, points of reference, and previous life habits (community).
- With a view to the long-term wellbeing of individuals, improving family social support policies can strengthen parent-child bonds to enable the growth of psychologically strong citizens and improve their **individual resilience capability**.
- Increase **pre-disaster attachment to place** in times of peace by creating places and time frames where citizens can experience community together. This can be done concurrently with disaster preparedness practices to strengthen the community and improve citizen resilience during crises.
- Pay particular attention to specific **age-related vulnerabilities** that can arise within specific contexts.

More information: BuildERS report D4.2

3.2 Impacts of flooding disasters and the COVID-19 pandemic on socially underprivileged groups and lessons for resilience improvement

Maira Schobert, University of Tübingen

3.2.1 Study rationale and approach

The aim of the German case study was to determine who is considered vulnerable by whom, what makes them vulnerable and how crises have affected different social groups. Based on the theoretical framework of the BuildERS project, vulnerability is understood as multidimensional and intersectional and describes the idea that disasters are not only the result of a hazard but of its interplay with a society, which is (not) appropriately prepared to deal with this threat. Every individual is potentially vulnerable. Whether particular conditions and characteristics lead to vulnerability depends on the context of the particular situation in which a person is. Therefore, the study explored what creates vulnerabilities and puts people in vulnerable situations.

The study focused on the impacts of the Elbe floodings in 2002, 2006 and 2013 and the COVID-19 pandemic in the city of Dresden and surrounding areas in the German federal state of Saxony. Together, the University of Tübingen and the German Red Cross used a twofold research design that combined expert interviews and a quantitative survey. Furthermore, these two research approaches compared

both previous (floods) and ongoing (pandemic) events to scrutinize disaster management measures regarding their ability to support individuals or to reduce their vulnerabilities in disasters.

In 2020 and 2021, 20 interviews with experts from disaster management agencies, the city administration, the social service department as well as social service providers from the Dresden city and region were conducted. A web-based survey with 118 participants targeted the general population of the area of interest to include citizens perspectives on the impact of the crises and crisis management.

3.2.2 Key findings

The study validated the situational dimension of vulnerability, based on the theoretical considerations of the BuildERS project. Contextual factors (e.g. the type of disaster, economic resources) influence who is rendered vulnerable to which degree. An important factor is what event people are facing, because depending on the event (flood or pandemic) those parts of the population who find themselves in vulnerable situations differ. The time and resources people have at their disposal for preparing for disaster was another influencing factor. Furthermore, the presence or absence of additional stressors, such as social disadvantages, being invisible to social policies or existing discrimination, also impact the level of vulnerability.

Furthermore, the extent to which social diversity is considered in the disaster management of the studied area and is included in the disaster plans and response varies. Overall, disaster management efforts often do not sufficiently consider social diversity, especially at the beginning of their relief activities. Often crisis management plans are based on imagined citizens who are fluent in the country's official language, able to read, able-bodied and capable of self-help. The needs of people who do not live up to these conceptions are often not considered and their vulnerability therefore increases. A core reason for this are the lacking linkages between disaster management and social service providers who could help to improve disaster management to be more inclusive. Additionally, the distribution of responsibilities between disaster management and citizens are often not clear for everyone.

A third finding is that during the floods and the pandemic alike, people who had reliable social networks as a crucial manifestation of social capital appeared to be less vulnerable. Their networks helped them to cope with the crisis and cope with its impacts. People who only had access to relatively weak social networks and lacked social capital were more vulnerable. They were also affected worse by the floods and the ongoing COVID-19 pandemic.

In addition, the results of the German case study showed the ambivalence of crisis management strategies. Although they help people to cope with crisis, they can also amplify existing vulnerabilities or even create new ones. For example, the measures that needed to be taken to mitigate the pandemic included physical distancing which increased the risk of loneliness and isolation for some people and hindered them from using their usual coping mechanisms. On a different note, those who are involved in disaster management and social services face increased risks

of becoming vulnerable themselves. Physical danger, a higher workload and a problematic work-life balance can create or increase their vulnerability as well.

Finally, psycho-social wellbeing influences how people can cope with crises. Crises themselves have a large impact on psycho-social wellbeing. Negative consequences for mental health are among the largest negative impacts and linger the longest. While most people struggled with their psycho-social wellbeing, there were also some people who apparently benefitted from the developments. For instance, one interviewee who worked at a childcare facility for struggling children and teenagers observed that many of them thrived during the evacuation and were able to 'function' better than in their everyday lives. They were able to cope well with the situation and this experience impacted their self-image positively.

3.2.3 Policy recommendations

Against this backdrop, some recommendations to improve disaster management were derived:

- The distribution of responsibilities needs to be communicated clearly and people need to be enabled to fulfil them.
- Improving crisis management requires both short-term adjustments and long-term changes of social structure. To increase resilience and decrease vulnerabilities the collaboration between disaster management and social services should be increased while social politics need to focus on reducing inequalities, discrimination and stigmatisation.
- Crisis management activities should be considered as a potential factor contributing to vulnerability. Implemented measures need to be analysed regarding their role in redistributing risks and harms.
- Psycho-social wellbeing needs to be recognised as a contributing factor to resilience and vulnerability and needs to be included in the overall crisis management.
- Social networks and social capital are powerful resources. At the same time, they should be recognised as situation-depended as they might not be accessible during crisis.
- Preparedness planning must consider the potential vulnerability and the embeddedness of disaster management personnel in different social contexts.

More information: BuildERS report D4.5, Factsheet on the BuildERS project homepage.

3.3 Vulnerability and the COVID-19 Pandemic—Insights from social care organisations and their clients

Alexandra Olson, The Salvation Army; Kati Orru, University of Tartu; Tor-Olav Naevestad, Institute for Transport Economics; and Kristi Nero, University of Tartu

3.3.1 Survey rationale and approach

In 2020, the research team (the Institute for Transport Economics, the University of Tartu, and the Salvation Army) developed a survey to gain an understanding of the ways that vulnerable segments of European populations cope with extreme events, with the focus on the COVID-19 pandemic. The main aims of this survey were to understand 1) the immediate and long-term consequences of these events, 2) what deficiencies in care might exist to these segments of the population, and 3) what resources are available to them to help them cope.

The framework for this study was developed by Orru et al. (2020) and follows the principles of the BuildERS framework (Morsut et. al 2020, see also Chapter 2.1) involving an intersectional and situational approach to vulnerability. The research team hypothesised that the vulnerability of individuals in a disaster depends upon the interaction or accumulation of different sources of vulnerability, e.g. living arrangements and other factors such as age, levels of education, and residence status. In addition to questions on the experiences with the pandemic, the survey sought to measure the level of engagement in protective and/or preventative behaviours, indicators of resilience, and levels of risk awareness.

The survey was implemented in thirteen countries: Norway, Estonia, Hungary, Portugal, Spain, France, Belgium, Denmark, the Czech Republic, Finland, Germany, Italy, and the Netherlands and involved clients of social care organisations and/or NGOs such as the Salvation Army or the Red Cross. The survey was conducted in the national language of the country by social workers or practitioners of these organisations. In total, 313 responses to the survey were gained from the 13 countries.

3.3.2 Qualitative study of the coping of social care organisations and NGOs

To explore the role of care organisations in supporting their clients coping in the times of the COVID-19 pandemic, the research team carried out a qualitative study involving social care organisations and NGOs in ten countries: the Czech Republic, Estonia, Norway, Finland, Germany, Hungary, Italy, Lithuania, Portugal, and the Netherlands (Orru et al., 2022). In total, 32 interviews and 5 online workshops were conducted with staff of soup kitchens, day centres, temporary shelters, and residential facilities to gain an understanding of how the work of these types of organisations was impacted by the onset of the COVID-19 pandemic. More specifically, the study investigated: 1) what obstacles or challenges arose for these organisations

as a result of the pandemic, 2) what factors assisted with or disrupted their ability to continue serving their clients, and 3) the outcomes for different segments of their client populations.

3.3.3 Key findings

As originally hypothesised, the results of the survey revealed varying experiences of the COVID-19 pandemic for clients of social care organisations due to the intersection of social categorisations, migration status, living arrangements, underlying health issues, income status, and level of exposure to the virus itself.

The level of protection provided by living arrangements was one of the main sources of vulnerability that was examined in the survey and was captured using the Framework for Understanding Homelessness on a Global Scale (Busch-Geertsema et al., 2016). Thus, respondents are divided into people living: 1) In their own homes, 2) In a centre/facility, 3) on the street or in a temporary accommodation. It was generally hypothesised that fewer negative impacts would be reported for people living in their homes and larger shares of negative impacts would be reported for people living on the street or in temporary accommodation, based on the differences in the level of marginalisation of these groups and the different levels of mental and physical strain that their living situations involve (Busch-Geertsema et al., 2016).

Figure 4 summarises some of the main results of the survey, focusing on mental and material impacts for the respondents. The figure shows percentages agreeing with the statements on negative mental and material impacts related to the pandemic, as well as levels of worry and frequencies of post-traumatic stress disorder-like symptoms related to the pandemic.

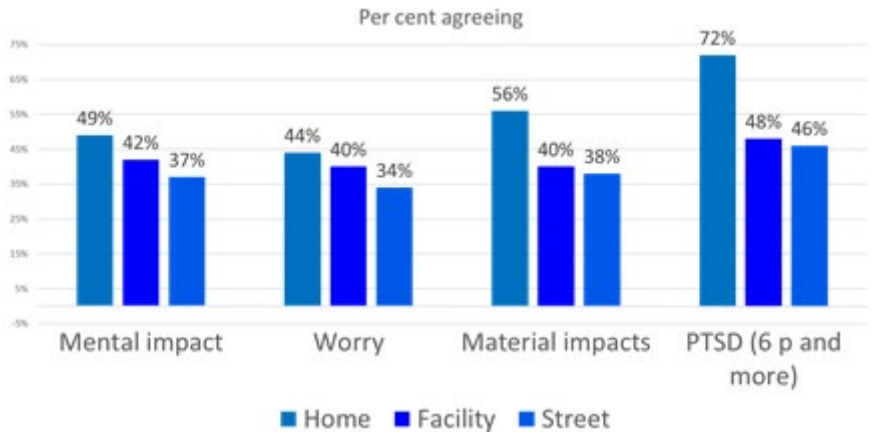

Figure 4. Mental and material impacts of the COVID-19 pandemic among respondents in the survey. Per cent agreeing.

In the following sections, these results and survey results in general, are discussed.

3.3.3.1 Impacts on socially marginalised individuals

One prominent example of intersections of various sources of vulnerability between respondents was illustrated in the material outcomes of the COVID-19 pandemic (Siimsen et al., under review). An increase in the age of the respondent, access to social benefits, and higher levels of individual psychological resilience were all related to fewer negative material impacts, respectively, while having a migrant background and increased exposure to COVID-19 were related to experiencing more negative material impacts. Somewhat surprisingly, it came out that compared to the individuals living on the street or in temporary accommodation, clients living in their own homes reported more negative material impacts due to the pandemic. There are many possible explanations for this but given the formulation of the question about negative material impacts (measured as negative effects on access to income, shelter food), it seems that more negative material impacts among people living in their homes could perhaps indicate that higher shares of respondents living in their homes had lost their incomes due to the pandemic (than e.g. among respondents living on the street or in temporary accommodation). We may also speculate that people who lived in their own homes but used social services perhaps were affected by poverty in ways which could lead to them losing their homes. This is something that people who live on the street or in temporary accommodation may have already experienced. Thus, the surprising results could be due to sudden (worsened) economic deprivation of respondents living in their homes, while respondents living on the street experience chronic deprivation. These different economic baselines may shed light on the different reports of the economic impacts.

Furthermore, the results of the survey revealed that although the COVID-19 pandemic can be considered a disaster in the traditional sense of material loss, there is also a significant psychological component to it (see Figure 4), with 42% of respondents agreeing that the pandemic had an impact on their mental health and/or mental wellbeing (Naevestad et al., under review). In terms of factors which exacerbate negative mental health outcomes, the survey revealed that identifying as part of a minority, previously being diagnosed with a psychological disease, and lower self-assessed physical health were prominent. In terms of experiencing symptoms of PTSD related to the pandemic, the survey revealed that having a migration background (in particular, being without documentation) and experiences with previous natural disasters or violent demonstrations such as terrorist attacks were exacerbating factors (Olson et al., in preparation).

3.3.3.2 Factors that helped or hindered coping

Social capital refers to the networks and relationships (e.g. with family and friends, with the area where they live, with authority figures) that an individual has. The sur-

vey revealed that respondents who were living on the street or in temporary accommodation had fewer close relationships, were less attached to their neighbourhood, and exhibited lower levels of trust in the authorities. In terms of engaging in protective behaviours to avoid contracting the virus, respondents with higher levels of social capital were more likely to engage in self-isolation (Naevestad et al., under review). Respondents were also more likely to indicate that they worried about a potential COVID-19 infection and exhibited higher levels of disagreement that the COVID-19 virus would not cause them notable harm if they had higher levels of linking social capital (e.g. relationships with authority figures). Lastly, and perhaps most importantly, the survey results indicated that respondents with higher levels of bonding social capital (relationships with family and friends) were more likely to have received help to get them through the pandemic.

In terms of risk awareness related to COVID-19, lower levels tended to be exhibited among respondents who were living on the street or were in temporary accommodation. Respondents with these types of living arrangements also tended to exhibit lower levels of fear in regard to the virus as well as lower levels of trust in the information about COVID-19 provided by the government or other authorities. Comparatively, respondents living in their own homes exhibited higher levels of risk awareness, however, residing in a country with high rates of infection as well as having lower overall assessed health, respectively, were also related to higher levels of risk awareness and higher levels of trust in the information provided by the government or authorities.

Sources of information about the pandemic were also indicators which provided further insight into trends regarding risk awareness. Television, for example, was revealed to be a main source of information for all respondent groups, while newspapers or the radio were additionally relied on by respondents living in care facilities/centres, while social workers or peers were important sources of information for respondents living on the street or in temporary accommodation. For respondents living in their homes, television and social media were relied on to obtain information. Further analysis of these results revealed a correlation between obtaining information from the television and engaging in self-isolation, worry about a potential infection, and trust in the government. Social media, on the other hand, was related to lower levels of worry regarding infection. Mechanisms behind COVID-19 scepticism are addressed in detail in Nero et al. (under preparation).

3.3.3.3 The role of care organisations

In addition to the survey data, qualitative interviews with the staff of social care organisations and NGOs provided further insight into the impact of the pandemic on their clients' mental health and mental wellbeing (Orru et al., 2022). The interviews revealed that social care organisations who provide help to people in vulnerable living situations experienced a surge in demand for shelter and food aid from clients. However, practitioners found themselves facing the threat of infection within their

organisations and were overburdened with new tasks (e.g. the digitalisation of services, interpreting official guidelines) and felt that these aspects were rarely met with the appropriate support from health and care authorities.

In spite of the relatively resilient response of the aid organisations and determination to continue providing care to their clients, the outcomes were worse for some types of vulnerable individuals than others. Next to psychologically fragile clients and migrants, new clients, individuals pushed into a vulnerable situation for the first time, were the critically challenged. Limited access to official (health) emergency services aggravated the situation of those who were already vulnerable (migrants, poor communication skills) during the crisis unless they were able to find support networks, e.g. from aid organisations. For clients living in their homes, loneliness due to isolation and uncertainty of what the future would hold was mentioned. For homeless individuals, the closure of day centres resulted in an inhibited ability to receive the same psychosocial assistance or maintain the same level of social interaction that they had prior to the pandemic. It was also difficult for some individuals to understand what was happening around them, which resulted in some anxiety and fear (Orru et. al., 2022).

The key impacts on the different types of organisations and outcomes for their clients are outlined in Figure 5

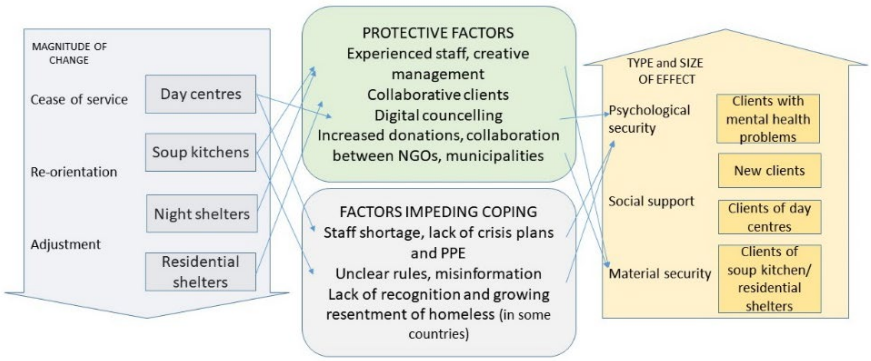

Figure 5. COVID-19 impacts on care organisations and outcomes for the different client groups (Orru et al. 2022).

3.3.4 Policy recommendations

- Crises like the pandemic hit the individuals who were already vulnerable and marginalised the most, pushing them to receive help from care organisations. Therefore, crisis funds, extra shelter space and other material (e.g. Protective equipment) and psychological (counselling, recognition) support needs to be extended also to care organisations to be able to meet the surge in demand for safe services.

- The representatives of care organisations need to be involved in official crisis management planning and in tailoring response measures for the interventions to reflect the needs of their clientele and other vulnerable segments of the population
- The staff of care organisations need to be recognised as the mediators/interpreters of official risk and crisis information for their clientele, including marginalised individuals. Their communication and guidance are essential sources of motivation for alignment with safety measures (Orru et al. 2022).
- Strategies and action plans should be formulated to address mental health outcomes for different segments of the population following a disaster.
- Community attachment is a key source of individual resilience and a key predictor of mental health outcomes. This indicates the importance of increasing attachment to the community and the living area through communal events and inclusive planning to mitigate critical outcomes in a disaster.
- To increase risk awareness and levels of trust, governments and authorities should tailor their communication strategies to different audiences, their preferences, and their needs.

More information: Orru, K. et al. 2022. Resilience in care organisations: challenges in maintaining support for vulnerable people in Europe during the Covid-19 pandemic. Disasters. DOI: 10.1111/disa.12526.

4. Tools and guidance to enhance disaster resilience

4.1 Knowledge into practical advice for resilience enhancement

Mark Rhinard and Jennifer Hinton, Stockholm University

4.1.1 Introduction

The BuildERS research project led to **a deeper understanding of resilience** in key areas. The first key finding is that vulnerability is dynamic and intersectional. Accordingly, we identified three main ways to increase resilience. First, reduce vulnerabilities by enhancing assessments and helping people in vulnerable situations. Second, build social capital by strengthening social support networks and combatting the effects of poor social capital. Lastly, increase risk awareness by improving risk and crisis communication and addressing information disorder.

These findings led to **direct implications for practice and policy** detailed in the BuildERS project deliverables D5.1 and D5.3. The way that vulnerability data is collected and assessed must be improved. Disaster planning and management should be made more inclusive by: 1) increasing interactions and dialogues between different stakeholders; and 2) involving vulnerable people and/or intermediaries in assessments and planning. Public support structures should be enhanced. There is a need to map and strengthen existing support networks. Crisis managers and first responders should more effectively engage with formal and informal volunteers. There is a need to improve communication strategies to reach the most vulnerable. Information disorder should be navigated and managed more effectively. The ethical implications of all recommendations should be considered.

Tools and innovations were developed in order to address these needs (e.g. the Vulnerability Assessment Tool, Ethical Assurance Guidelines, the Inclusive Crisis Communication Canvas, and the First Responders' Training) and are included in some of the policy recommendations below. These tools are discussed more specifically in other sections of this chapter and are also detailed in the BuildERS project deliverables D4.8, D5.2, D5.5, D6.4, D6.5, and D6.6.

4.1.2 Key policies and actions for increasing resilience

The BuildERS project focused policy recommendations on three different governance levels: local, national and EU. Below are some key policy recommendations, grouped by the relevant governance level.

Firstly, all governance levels can work to address vulnerabilities, by involving a diverse group of actors in mapping and analysing vulnerabilities, developing strategies for tackling vulnerability, and emergency planning processes so that solutions

to reduce vulnerability can be developed jointly. More specifically, they can host critical discussions on existing approaches for measuring vulnerability, to get a thorough understanding of their strengths and weaknesses. We recommend hosting debates on what responsibilities governments, authorities, communities and individuals have (and can take on) in terms of building resilience and reducing vulnerability. Diverse groups of actors include:

- NGOs and care organizations related to caring for people with certain impairments, family arrangements, age groups, gender, cultural backgrounds,
- representatives of marginalized people,
- social service providers,
- institutional actors related to emergency management,
- first responders,
- researchers, and
- local/national level authorities and policy-makers.

To build social capital, policy makers should allocate resources that make resilience-building activities affordable and accessible to all individuals and groups (e.g. earthquake secure housing in earthquake prone areas, purchasing disaster-related insurance). This includes improving the provision of psychological support to maintain and strengthen resilience and coping capabilities, as well as boosting the capacity and quality of mental health services, in general. Dedicated strategies should be developed to support individuals in building individual preparedness and self-help capabilities. Psychological support needs to be considered not only as an issue for social services but also as a 'disaster management' related issue. Lastly, free and open training needs to be provided to increase practical skills in first aid training (including first aid lessons for pupils in secondary schools and including first aid for mental health/psychological emergencies); skills to cope and help in extreme conditions; how to offer support to individuals considered most vulnerable (e.g. elderly with impairments).

To raise risk awareness, communication strategies should be tailored for vulnerable people, and resources should be devoted to learning more about the communication needs and preferences of the most vulnerable. This includes engaging with those in close contact with potentially vulnerable people. Diverse populations and those with communication difficulties should be considered when creating risk awareness campaigns. The BuildERS Inclusive Crisis Communication Canvas was developed to guide and facilitate this process. It is also important to work together with intermediaries (such as care organisations, NGOs, local leaders) to identify which communication materials are most useful for vulnerable people in their care. This includes using multiple voices (such as doctors, journalists, and therapists) to communicate risk messages, as well as using multiple platforms (including social media, government spokespeople, traditional media).

The European Union can help reduce vulnerabilities by developing a framework of ethical principles for better engagement. Through the Directorate-General for European Civil Protection and Humanitarian Aid Operations (DG ECHO), a framework

needs to be developed for ethical principles for involving representatives of vulnerable people in vulnerability assessments and wider emergency preparedness activities. We encourage the use of the BuildERS Guidelines for Ethics Assurance to inform such a framework.

To build social capital, EU-level policy-makers should reduce inequality and discrimination. In particular, we suggest mainstreaming the reduction of inequality and discrimination in European funding streams, across sectors. Social capital for resilience can also be built by improving the use of volunteers in disaster management, add **volunteer coordination planning** to the work of DG ECHO's training schemes. Best practices need to be shared between states in how to integrate volunteers in disaster management through the network of civil protection actors.

To raise risk awareness, member states must be helped to adopt best practices for inclusive communication. Existing networks developed in DG ECHO should be used as part of civil protection coordination, to help member states collect, present and employ **best practices for inclusive communication**. One opportunity is to use the new Civil Protection Knowledge Network. Social media training should be provided to civil protection coordinators. For instance, **social media training should be included in civil protection** coordinator meetings (DG ECHO). This should include the sharing of best practices against disinformation.

Lastly, research needs to be funded on the role of social media in disaster communication, in particular the needs to be a focus **on the advantages and disadvantages of using social media as a communication tool during disasters**.

National policy makers can work to reduce vulnerabilities by publishing **national guidelines** to assist local authorities in taking a broader view of what constitutes vulnerability, and how vulnerability changes. This includes considering how national policies related to urban-planning, family support, social integration, and other welfare-oriented policies, can reduce or increase vulnerability during disasters. This process can be guided by the BuildERS Vulnerability Assessment Tool, and other tools in the Inclusive Crisis Management Toolbox.

To build social capital, strategies should be developed for **strengthening community support networks** including private citizens, aid workers and other intermediaries. First, **resources should be provided to local authorities** to map such networks, then those intermediaries need to be included when identifying needs. We encourage the use of the BuildERS Inclusive Crisis Management Toolbox. Second, provide incentives for **local organisations to invest in social network building activities**, including activities and events related to crises and coping. Additionally, the engagement of volunteers should be improved during crises, a **dialogue should be facilitated between official crisis managers and volunteer organisations** to explore the advantages and disadvantages of volunteer engagement. Local authorities should team up and **develop plans for managing 'volunteerism'** during crises, e.g. concerned citizens who wish to help in a disaster. **Local planning** should be encouraged for coordinating official volunteers (those enrolled in organisations) and unofficial volunteers (spontaneous helpers) during crises.

To improve risk awareness, the spread of disinformation via social media, should be studied, countered and prevented. Resources should further be devoted to studying the cause, forms, and effects of social media '**disinformation**' that can hurt risk awareness in a community. This new knowledge should be used to **build strategies to counter disinformation**. **Social media literacy** education campaigns should be organised for the public. Lastly, **specific units should be dedicated within government agencies to monitor social media**, and fact-checking help lines (for telephone inquiries) should be set up to strategize public communication strategies.

Local policy-makers can reduce vulnerabilities by taking a broader view of vulnerability in disaster planning. This means that disaster planning should take a **broader view of what constitutes vulnerability**, including individual (e.g. mental health), group (e.g. community exclusion), and disaster-specific issues (e.g. electrical outages in low-income areas). They should also recognise that vulnerability is a changing, not permanent, condition. We encourage the use of the BuildERS Vulnerability Assessment Tool in this process.

To build social capital, a social media strategy needs to be developed to help: (a) mobilise volunteers, (b) deliver accurate information, (c) monitor misinformation and (d) assist with situation awareness during a crisis. The BuildERS Guidelines for Collaborating with Social Media Influencers can be helpful in this effort. Social media should be used for **risk communication on an ongoing basis**, not only during disasters, to build trust and followers. We encourage the use of the BuildERS Inclusive Crisis Communication Canvas, as well as the BuildERS Guidelines for Collaborating with Social Media Influencers.

To raise risk awareness, first responders should be educated in communication strategies, and **how to make risk and crisis communication accessible** to people with mental health difficulties or who live in isolated circumstances. The BuildERS Training for First Responders pilot project can be useful in these efforts.

More information: BuildERS deliverables D5.1 and D5.3.

BuildERS Tools see BuildERS deliverable D6.6 and the Results page on the BuildERS website: https://buildersproject.eu/results

4.2 Vulnerability assessment tool for disaster planning and response

Kati Orru, University of Tartu; Margo Klaos, Estonian Rescue Board; Kristi Nero, University of Tartu; Friedrich Gabel, University of Tübingen; Sten Hansson, University of Tartu, and Tor-Olav Naevestad, Institute for Transport Economics

4.2.1 Why we need a new tool for assessing disaster vulnerability

Vulnerability assessments should play a crucial part in risk analysis and preparedness-planning to enable more informed decisions by individuals as well as institutions. However, our analysis of eight BuildERS partner countries (Orru et al., 2021) demonstrated that social vulnerability analyses are rarely included in preparedness planning or crisis response decision-making. Most of the countries plan their crisis response around pre-determined vulnerable groups (e.g. elderly, individuals with chronic diseases), thus disregarding the place- and hazard-specific contextual measures of vulnerability. The practitioners engaged in the study also admitted their limited knowledge about how vulnerabilities could be identified.

In the BuildERS project, we addressed this lacuna in situation-specific vulnerability assessment approaches and in collaboration with 119 practitioners and academic experts. We developed and tested of a novel tool described in "Imagining and assessing future risks: A dynamic scenario-based social vulnerability analysis tool for disaster planning and response" by K. Orru, M. Klaos, K. Nero, F. Gabel, S. Hansson, T.-O. Nævestad (under review in the Journal of Contingencies and Crisis Management). The designing of the tool was user-centred, taking Estonia with its recent experiences in major crises (long-term disruption of electricity, the COVID-19 pandemic and a cyber-incident concerning state health information systems) as a reference.

4.2.2 The 5 stages in the novel vulnerability assessment tool

The key stages of the new scenario-based tool for vulnerability assessment are presented in a nutshell in Figure 6. The key analysis unit in the tool are the individuals affected by particular vulnerability factors. Therefore, each row in the figure depicts one factor of vulnerability and the individuals who are burdened with this vulnerability factor. In an example of vulnerabilities in the long-term disruption of electrical supply, such an analysis can provide essential input for organising well-targeted crisis communication and/or evacuation.

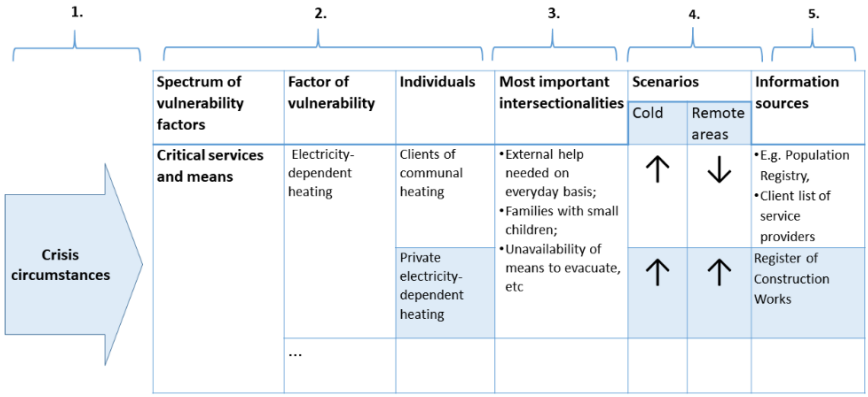

Figure 6. Key stages in the vulnerability assessment tool. Example of the operationalisation of the factors of vulnerability under the dimension “Critical services and means”.

1. The tool takes a particular scenario or crisis situation at hand as a point of departure. The scenario circumstances (e.g. the type and degree of emergency, environmental, technological circumstances or crisis measures) shape the configurations of hazard exposure, coping and/or adaptive capacities in individuals.

2. Specifying which individuals are burdened with vulnerability factors. The tool uses the novel conceptualization of vulnerability factors related to human agency and capacities and technological functionality as well as social support through private relations and public services, as proposed by Orru et al. (2021) (see also Chapter 1.2 in this handbook). The model (Figure 7) suggests that four spectrums of vulnerability factors—individual capacities, societal support networks, critical infrastructure, and public support services—need to be considered. The evaluation of the relevance of these factors is conducted based on expert assessments, learning from previous experiences, and in exchange with the representatives of affected people using the Delphi method (allows participants to revise their assessments after reflecting on others’ views).

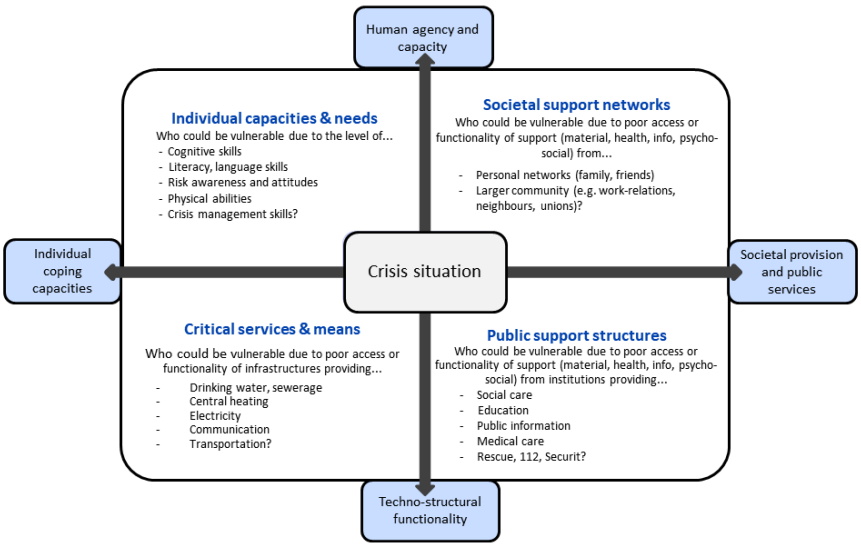

Figure 7. Conceptual dimensions of 'social vulnerability' in disaster management (Orru et al., 2021).

In an example of a disruption of the electrical supply (Figure 6), in the "Critical infrastructure and means" dimension, one of the vulnerability factors is the lack of alternatives to electricity-dependent heating. The individuals who may be hampered due to this factor involve communal heating clients and users of private electricity-dependent heating systems.

3. Determining the vulnerability factors that intersect in unique ways in a particular situation. This narrows the circle of vulnerability factors and the affected individuals who need the most attention in a specific situation. The four spectrums of vulnerability factors intersect in unique ways, creating synergies, aggravating or balancing each other out depending on the specific crisis situation. Figure 8 depicts the intersecting vulnerability factors in the event of a long-term disruption of electricity.

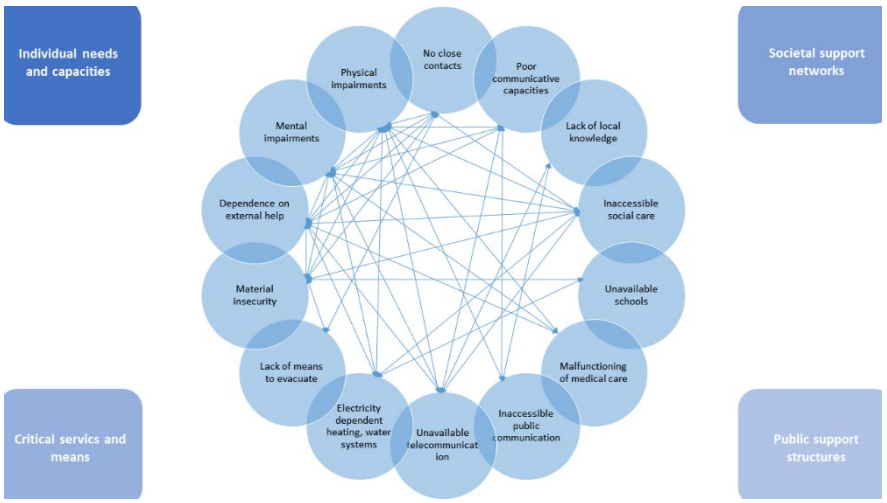

Figure 8. Example of intersecting vulnerability factors in the event of a long-term disruption of electricity.

4. Evaluating the dynamics in vulnerability factors in derivations of the initial scenario. The relevance of the vulnerability factors may change if the base scenario changes and different crisis circumstances (e.g. a cold season) come into play. Therefore, the tool helps to assess the dynamics in vulnerability factors in case certain contextual parameters are changed.

5. Connecting the factors of vulnerability with the indicators of vulnerability in specific databases and other information sources, laying out openly which information sources are used in vulnerability assessment. The testing revealed that combining several indicators from several datasets would enable a cross-sectional and more detailed depiction of vulnerabilities: an essential overview of the potential vulnerability mixes in specific regions in specific situations. However, more direct measures of disaster-vulnerability, e.g. beliefs and preparedness practices need to be retrieved from group-based data in surveys, in depicting the users' experiences of accessing or activating the support from societal networks or public support structures expert views from representatives of diverse society are irreplaceable (Figure 9).

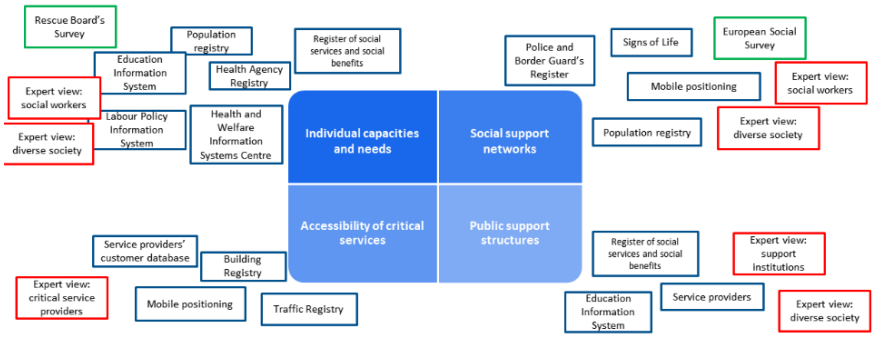

Figure 9. Examples of information sources pertaining to the four spectrums of vulnerability factors.

4.2.3 Key lessons from testing the vulnerability assessment tool

The stakeholder validation proved that the proposed vulnerability assessment tool has high potential to benefit the institutions that are tasked with preparing risk analyses and plans for crisis management, including government authorities (e.g. rescue and health boards), providers of vital services (e.g. electricity, communications), local governments (including social care departments), but also NGOs supporting rescue and social care (shelters, soup kitchens). The novel tool advances the risk assessments and crisis management planning in at least four ways:

1. It moves beyond the pre-determined group-based understanding of vulnerability by explicating manifestations of vulnerability through the dimensions of human agency and technological structures as well as informal and formal social support and considers their synergies and cascading effects when intersecting in certain individuals or groups.
2. Thorough predictions of the situation-specific manifestations of vulnerability factors in the strategic preparedness-planning phase that can be further specified in a specific crisis response situation will enable better targeted and resource-efficient crisis communication and support.
3. It increases the fairness of the assessment and related crisis planning by engaging the representative of diverse and potentially most affected members of society with the help of the Delphi method.
4. It lays open the different sources of information on vulnerability to improve the transparency of the decision-making.

More information: Orru, K. Hansson, S., Gabel, F., Tammpuu, P., Krüger, M., Savadori, L., Meyer, S. F., Torpan, S., Jukarainen, P., Schieffelers, A., Lovasz, G., Rhinard, M. (2021). Approaches to 'vulnerability' in eight European disaster management systems. Disasters, 46 (3). DOI: 10.1111/disa.12481.

Orru, K., Klaos, M., Nero, K., Gabel, F., Hansson, S., Naevestad, T-O, (under review) “Imagining and assessing future risks: A dynamic scenario-based social vulnerability analysis tool for disaster planning and response” in Journal of Contingencies and Crisis Management.

4.3 The inclusive crisis communication canvas

Marianne Mela, Pirjo Jukarainen, and Miia Myllylä, Police University College

The Inclusive Crisis Communication Canvas Tool was designed to help crisis managers to address various communication-related factors that may affect people’s capacity to prepare for and respond to disasters (Hansson et al. 2020). It also promotes inclusivity, which refers to practices and policies of providing equal access to opportunities and resources for people who might otherwise be excluded or marginalized.

Our tool is been based on the Business Model Canvas, developed in 2005 by Alexander Osterwalder. The original Business Model Canvas is distributed under a Creative Commons license from Strategyzer.com. In the EU-funded Unity project (2015–2018 – before the BuildERS project started), the Police University College of Finland utilised the Business Model Canvas as an inspiration in the design of a tool for community policing. The tool, called the Service Design Canvas for Community Policing (SDCCP), helps local police units to address and prioritise the needs of communities and citizens. Similarly to the Inclusive Crisis Communication Canvas tool, the SDCCP tool assisted in the definition of the main communication and contact channels with the above-mentioned stakeholders.

In the BuildERS project we decided to use the previous good experiences of the service design tool for community policing, to help create a corresponding tool for crisis communication. Our aim was to create a practical and user-friendly tool that would synthesise several of the key outcomes of the BuildERS project in a coherent and understandable way. SWOT, PESTEL or other environmental analysis methods can be used together with the Inclusive Crisis Communication Canvas Tool to analyse various factors of the crisis communication. It is easy-to-use, concise and free of charge. With the help of the Inclusive Crisis Communication Canvas Tool, practitioners can improve their crisis communication for example by:

- choosing communication methods and forums that make the shared information accessible to all people, and
- building partnerships that lower the threshold to contacting and communicating with the authorities.

The development of the Inclusive Crisis Communication Canvas Tool started from drafting the guidelines and a 'Canvas' template for the first responders and crisis managers. The Canvas tool and the Guidelines were piloted by four of the BuildERS projects’ first responder partners during October and November 2021.

The pilot took place in Germany, Italy, Estonia, and the UK. We hope that our prototype serves as inspiration for other initiatives and actions in making crisis communication more inclusive. For instance, it would be beneficial to create a technological tool that would replace the paper worksheets.

The Inclusive Crisis Communication Canvas Tool consists of two parts: guiding questions for the strategic analysis process, and a printable worksheet to summarise the results of the analysis. The worksheet can be outlined on one page; therefore it provides nicely a quick overview of the communication strategy. The worksheet comprises of seven analysis sections: 1) Target audiences, 2) Aims and benefits 3) Methods and channels 4) Relationships with the Target audiences, 5) Key partners, 6) Key resources, and 7) Key Activities.

In sum, the Inclusive Crisis Communication Canvas Tool is a preparedness tool that helps to identify individuals who are at risk to be forgotten in crisis communication and who may have difficulties to understand and adopt protective measures. Which channels for instance provide alternative formats (e.g. sign language, tactile signing, audio format or large print) for accessing crisis-related information? Furthermore, we advise practitioners to map the potential intermediaries who can be reached and trusted by the target audiences. Moreover, who would be able to collect information about the needs and overall situation of vulnerable individuals, for example whether they safe or whether false information might be placing them in harm's way?

We recommend that crisis managers prepare a fictional crisis scenario, and then use it as a source for the analysis. The fictional crisis scenario may relate for example to a natural disaster, mobilisation of communities for conflicts, or other type of crisis. By using different scenarios, it is possible to test the crisis communication strategy before a crisis emerges.

More information: Jukarainen P., Mela M., Valsta E., Orru K., Latvakoski J., Lusikka T., Keränen J., Pilsas G., Rhinard M., Kuran C., Gabel F., Berawi M.A., Kajganovic J. and Vrabie C. (2022) D6.6, Stakeholder validation of research findings and co-creation of innovations, BuildERS project report.

4.4 Training for the first responders to improve their risk and crisis communication

Pirjo Jukarainen, Marianne Mela, Miia Myllylä, Camilla Kattelus, Johanna Argillander, and Suvi-Tuuli Ames, Police University College. Jaana Keränen, Merja Airola, and Riitta Molarius, VTT Technical Research Centre of Finland

During our co-creation activities with stakeholders, it became evident that crisis managers need to build partnerships with the intermediaries of people who find it difficult to communicate or interact so that risk and crisis related information can be better reached, understood and acted upon. For instance, the participants in the

BuildERS research results validation workshops noted that as non-profit sector agencies are important intermediaries of vulnerable people. The workshop participants were working in care organisations and often need to "translate" the authorities' instructions and guidelines for their clients.

Stakeholders had noticed that individuals with psychological diagnoses may have a hard time comprehending all of the information related to a crisis because it might trigger anxiety, etc. Additionally, people with alcohol addictions are often affected by it psychologically and have difficulties understanding adequately what is happening. People suffering from substance addictions were also prone to believing false information (i.e., alcohol can kill coronavirus or certain drugs would boost their immune system).

It was also noted that limited translations of the information in different languages made it difficult for some individuals to receive information. Intermediaries are needed also to reach migrant communities, which may have lower levels of trust towards authorities. Roma communities have also been sometimes sceptical of official information and the hidden purposes behind it (i.e., the idea that someone is earning money because of the COVID-19 pandemic, or that it was a way of controlling movement). This might be related to their (current or past) experience of being discriminated and stigmatized, and, as a consequence, limited trust in the authorities. During the COVID-19 pandemic a great deal of false and harmful information spread, and various conspiracy theories have made people more vulnerable. The BuildERS project researchers Hansson et al. (2020) suggest that during the pandemic, exposure to harmful information may have made people more vulnerable in several ways:

- discouraging appropriate protective actions and tricking people into buying fake protection,
- promoting the use of false (or harmful) remedies,
- misrepresenting the transmission mechanisms of the virus and victimising the alleged spreaders of the virus via harassment/hate speech,
- downplaying the risks related to the pandemic, and
- tricking people to reveal their confidential information.

Some of the difficulties in communication and/or interaction derive from memory loss, language problems, or reduced reasoning skills. Therefore, people may have less capacity than the so called neurotypical people to express themselves and are at risk of being either misunderstood or side-lined. Common for these individuals is that their challenges in terms of communication and/or interaction may remain unnoticed, as they are not always visible. Furthermore, because of their difficulties in self-expression, they may be completely ignored as conversation partners.

This has both practical and ethical implications. First, if the interaction and communication fail, people' needs in crisis may be side-lined and/or they may not be able to ask for help or tell that they are injured or in pain. Second, according to research, individuals with mental health conditions and/or brain disorders are more prone to believe misleading and/or false information (misinformation) than control

groups. This is because certain cognitive functions such as verbal fluency, analytical thinking and numeracy skills are related to the accuracy of judgement and decision-making, and our thinking styles: whether they are more intuitive than reflective (Matei et al. 2020; De Keersmaecker and Roets 2017).

In the BuildERS project we have promoted the principles of accessible and inclusive crisis management, stated in the Sendai Framework for Disaster Risk Reduction 2015-2030 (UNISDR 2015). Communication with first responders needs to be accessible to people with disabilities, and people with disabilities need to have the devices they require to communicate with first responders (GFDRR 2018). Furthermore, many neurodivergent people have exceptional skills such as absorbing large amounts of information or excellent memory of details. In chaotic and complex crisis situations, these types of skills can be potentially very beneficial for coping with crisis but also overwhelming for the individuals. For the first responders, however, detailed eyewitness observations of incidents, and/or identified characteristics of suspected perpetrators (in man-made crisis), are valuable information.

For the above mentioned reasons we saw it as important to create training that would increase first responders' knowledge of factors that hinder social interaction and communication (such as comorbid symptoms related to mental health conditions, brain disorders/neuropsychiatric disorders, and intellectual disabilities). We have designed educational tools that use innovative pedagogical methods: including gamification and scenario-based simulation. The first chapter describes the learning objectives and methods of the first responders' training. Our prototype has been designed especially for the police and the rescue services, to improve their risk and crisis communication (Figure 10). The training is built on an idea of competence-based learning of communication and interaction skills, collaboration skills, and accessibility requirements for crisis-related information.

The training is comprised of several modules, which teachers and trainers can integrate into their course contents. This adds flexibility in the implementation and lowers the threshold of including externally designed methods and materials in teaching. It will also support the idea of mainstreaming the principles of accessible and inclusive first responder services in other education. The training has two larger thematic sections with different target groups and learning methods:

1) *External communication and interagency collaboration*. This section is designed for communication specialists and duty commanding officers who are responsible of communication. It is formed around a half-day preparedness drill, which uses an online platform to simulate external communication via digital communication channels. The aim is to learn accessible risk and crisis communication, and ways to collaborate with the relevant intermediaries of vulnerable people. An important aspect of the training is a simulation of the vulnerabilities that are created by exchanging information via social media and other digital communication channels. Preparedness drill participants learn the logic of information disorder: how false and harmful information spreads, and how it can be—at least partially—tackled.

2) *Social interaction and communication with people who have special needs in terms of communication*. This section is targeted for field operations officers who respond to emergency situations and interact with citizens, and students of basic vocational training. It is an e-learning environment with interactive learning materials. Learners are shown videos, which simulate face-to-face interactions and explain better and not such good ways to communicate. The learning materials also provide knowledge of common neuropsychiatric disorders, cognitive disabilities and mental health conditions that affect the ability to understand and act upon information. Furthermore, the training deals with the first responders' own psychological resilience and gives tools to strengthen it.

The last mentioned training module has been built on the research findings of the BuildERS project that have shown how also the crisis managers themselves can be vulnerable in disaster situations. Therefore, our training aims to also improve the resilience of the first responders themselves. It deals with the mental health and coping with long-term stress and post-traumatic disorders that may arise due to work. The module explains how the factors that burden our own ability to think, memorise things and solve problems also affect our encounters with others, such as clients. During the course, the students will learn methods to strengthen their ability to function and increase their personal resilience, ability to recover and move on from mentally stressful situations.

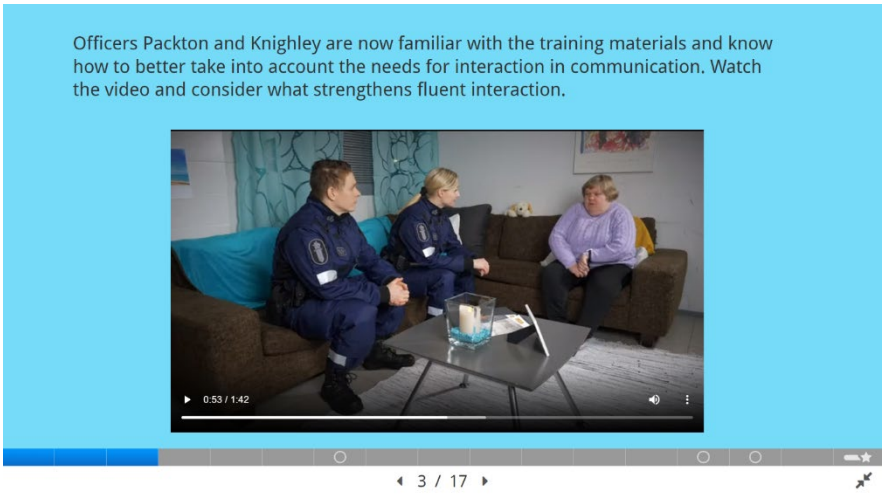

Figure 10. Screenshot of the training materials.

In sum, the training aims to build the capacity for both external communication and face-to-face encounters and interaction with people who have a variety of diverse needs in terms of communication. Specific sub-themes of the training contents are responding to false and harmful information and finding strategic partnerships with other agencies. Students will gain knowledge of the accessibility requirements for risk and crisis communication and understand what constitutes easy-to-read and plain language. They will also learn to use the potential of an individuals' social network including their connections to the different service providers. In practice, this would mean that first responders (such as police or rescue services) engage in multiagency and multi-professional work to reduce individuals' vulnerabilities.

The training course will be available for self-learning in two different e-learning environments. The English course will be open for self-registering on the LEEd-platform of the European Union Agency for Law Enforcement Training CEPOL. This platform has around 30,000 users of online training who are registered officials across the EU Member States and several other countries and partner organisations. In addition to being accessible by computer, LEEd can also be accessed via mobile devices with an app.

Furthermore, on the Moodle platform maintained by the Police University College there will be courses in Finnish and Swedish annually for an approximate 2,000 field operations officers and commanders, and around 500 bachelor's degree level students. It is also a plan to make a course in English for students participating in the Nordcop exchange programme of Nordic police academies or the European Erasmus+ exchange programme who are visiting the Police University College. Although the pilot training materials were designed especially for law enforcement, they can be easily modified for the other first responders such as paramedics and fire-fighters. In the near future, with additional external or in-house funding, we aim to build an even larger e-learning environment for a variety of crisis management agencies.

More information: Jukarainen P., Myllylä M., Kattelus C., Mäkelä R., Ames S-T., Argillander J., Bäck A., Lusikka T. (2021) D4.1 Managing chemical spill emergency and mis-/disinformation through simulated responses, BuildERS project report.

4.5 Board Game

Jelena Kajganovic, Geonardo Environmental Technologies Ltd.

The BuildERS Board game teaches elementary school children aged 5 to 10 how to react and how to spread information to their peers. In the BuildERS project report: D1.3, the elderly, children, and people with disabilities are recurring groups impacted by crises in all eight countries that were subject to analysis. This game is

focused on explaining to children the steps to be taken in case of emergency situations focusing on natural disasters or other events. Four different scenarios have been developed: fire, earthquake, flood, and pandemic.

Based on an extensive literature review of the pedagogical and didactical approaches in game-based learning, it was decided to create different levels of difficulty of questions. Questions for younger groups of pupils (5 to 7 years of age) are based on visual card pairing (e.g. a fire extinguisher and a fire; a face and a mask; a mobile phone with 112 displayed and a building on fire, etc.), whereas questions for the group 8 to 10 years of age are more complex and can also be in the form of challenges (either on paper or as physical demonstrations).

The prototype of the game was distributed to one elementary school and one children's camp in Hungary to be tested. The feedback received was mostly positive—the game was reported to be engaging, the visuals were interesting and the level of knowledge on the topic among the children increased. The game, however, needed some simplification and after adjustment according to the testers' comments, the instructions were clearer. The updated version of the game was tested in a new school and an additional camp for disadvantaged children, which was intentionally done to check the applicability for this target group. The feedback received was positive, without any issues in terms of understanding of either teachers/educators or children.

Moreover, the game was designed with co-creation in mind in another way—the visual elements. Each of the four boards is only partially coloured, so that the children playing can firstly connect to the game while colouring in the town and investing some joint effort to make it "their own". With this step, especially for the younger age group, it will be easier to engage and potentially make the board look like their own town, city, school, playground, etc. (see Figure 11)

The game will be available in five languages (English, Finnish, German, Italian and Hungarian). It will be distributed across the schools in the countries where these languages are spoken, while it is also planned to reach out to organizations dealing with non-formal and informal education of children 5 to 10 years of age. The idea is to target organizations dealing with especially vulnerable children (migrants, disadvantaged children, children with development difficulties) and local NGOs and community centres.

Figure 11. The board game.

The game will be available primarily on the BuildERS project website, but it is going to be distributed to adequate platforms, namely the Horizon Results Platform and School Education Gateway to specifically target teachers, as this is a popular platform for teaching materials and a hub for motivated educators. In addition, the eTwinning National Support Services (NSS) of these countries will be contacted to distribute news about the game. eTwinning is the largest network for school staff in Europe, with over 450,000 registered teachers. The NSS social media channels are extremely popular, and especially among teachers who are used to using innovative teaching methods and tools, which the BuildERS project game represents. These outreach activities will put the game on the map with the relevant organizations and platforms that can remain a source of information even after the project is done.

More information: BuildERS report D5.2.

The board game can be downloaded from the BuildERS website and printed out on A4 sheets of paper to ensure wide-spread accessibility. It will be distributed across other educational platforms, offered to other projects as well as schools.

4.6 Guidelines for collaborating with the social media influencers

Emilia Valsta, Pirjo Jukarainen, Miia Myllylä, and Marianne Mela, Police University College; Venni Arra and Mathilda Englund, Stockholm Environment Institute

Social media is undoubtedly one of the most important channels through which governments inform their citizens and communicate with them. The role of social media as a source of information can even become more important before, during and after a crisis. Crisis managers' collaboration with social media influencers aims to use digital trust networks in a novel way. Social media influencers are actors who have established a significant number of relationships in the social media community with a specific quality to and influence on organizational stakeholders through content production, content distribution, interaction, and personal appearance on the social network (Enke and Borchers 2019). To reach their citizens public actors could use the help of social media influencers who often have thousands or even hundreds of thousands or millions of followers.

Social media influencers have been active in working together with public organizations in raising awareness and sharing information on different topics. For instance, Swedish lifestyle influencer Angelica Blick interviewed the Minister for Social Security about the COVID-19 pandemic based on questions raised by her followers. Social media has also been used in organizing help during crises. For instance, the German local community coordinated their civilian relief efforts through Facebook during the Elbe flood of 2013 in Dresden, while in Greece during the wildfires in 2018, singer Sakis Rouvas used his Instagram account with 900,000 followers to inform people of the needs of local health authorities and first responders for people who could donate blood, to mention a few examples.

As the collaboration with influencers in risk and crisis communication is a rather new practice, we decided to develop guidelines for practitioners. We hope that our guidelines help public actors navigate the world of social media influencing and harness the field for risk and crisis communication. The goal was to create practical, concrete guidelines on how to collaborate with influencers and what to consider before, during and after collaboration. However, being funded by tax-payers, serving all citizens and having to build and maintain public trust, public actors must take various additional aspects into consideration when collaborating with individuals instead of companies. That is why we wanted to include a section focusing on ethical considerations and risks.

The guidelines were created iteratively based on several sequential steps. Crisis-scenario-based tabletop exercises held in spring 2020 in Estonia, Finland, Germany and Italy confirmed that authorities and other responsible organizations cannot manage alone in sharing crisis-related information. New types of collaborative relationships such as the involvement of virtual volunteers or social media influencers were welcomed, yet, the tabletop exercise participants emphasized that these supportive non-official actors should be trained, kept constantly informed of the legitimate information and their actions should be coordinated. Collaboration with social

media influencers in raising awareness of a crisis was considered to be a double-edged sword: responsibly-acting influencers can be of great help, but they may also accidentally spread false information. Participants also suggested that adding humour to the awareness raising activities may help, even if the issues are serious.

The European Union has recognized that false information is a significant challenge for Europe and that inclusive solutions are necessary. Furthermore, in December 2020, the Council of the European Union noted that the current COVID-19 pandemic makes the EU and its Member States more vulnerable to intensified and more sophisticated spread of disinformation and manipulative interference. The Council called for a multidisciplinary and multi-stakeholder approach to tackle the increased spread of disinformation (Council of the European Union 2020). Impactful long-term solutions require awareness-raising, media and information literacy, stakeholder involvement and cooperation between public authorities, online platforms, advertisers, trusted flaggers, journalists, and media groups (European Commission 2018).

In autumn 2020 and early in 2021, we organised a series of online workshops on information disorder held with Estonian, Belgian, Italian, Portuguese and Swedish risk and crisis communication experts. These workshops dug deeper into the challenges of false and harmful information. The workshop participants saw that due to their popularity, influencers have the potential to reach wide audiences, and especially those individuals who do not necessarily follow traditional media. For example, youth who regularly follow certain video bloggers could be reached via these influencers. Furthermore, the participants stated that influencers could support authorities in gaining acceptance of the restrictions and changing unwanted behaviour, attitudes and values of masses during crises, such as keeping a distance and refraining from socializing in the case of the protracted pandemic. For example, influencers could share infographics and other awareness raising material provided by the authorities and other responsible agencies. They could also share their personal experiences and everyday examples of the impacts of crises. With their face and voice, they could provide a necessary push in the right direction.

The results were then consolidated into the guidelines, which consist of three sections: 1) Why collaborate? 2) What is social media influencing? and 3) Getting started.

The first section (Why collaborate?) the guidelines make the case for why public actors should collaborate with influencers to improve risk and crisis communication. Social media has the power to directly influence how people prepare for, respond to and act in a crisis situation. Influencers are important messengers in the fabric of social media. They know their followers, what people like and how to reach them. Thus, collaborating with them is also efficient because as experts they can help design an effective campaign.

Social media influencers are able to narrate crisis-related information in an entertaining way (providing infotainment or edutainment), and thus raise attention for instance to official instructions, orders and warnings. Influencers are very good storytellers and able to touch people's emotions. If they are able to share verified information, they can debunk myths, rumours and misunderstandings and help to fight

against harmful conspiracy theories that often emerge during crises. Social media influencers can also serve as role models and advocates for risk awareness, promote preparedness actions and safety measures. They can share their experiences of doing their daily chores during (an earlier) crisis, tell narratives of being (once) a victim or survivor or providing support for others. In other words, they could be the bonding social capital of the individuals in a vulnerable situation.

In the second section (What is social media influencing?) provides an introduction into the subject of social media influencing. It examines what types of influencers are out there and how to choose the right influencer to work with. Influencer marketing is generally based on a strong sense of authenticity and people trust them more than celebrities (Schouten et al. 2019). The idea is that the influencer's followers are committed to the content although there exists a trade-off between the follower count and engagement and price of the campaign. As a rule, the larger the audience the less focused the content and engaged the followers are, and the higher the cost to collaborate with that influencer in a campaign.

Influencers are often categorised globally into four categories based on their follower count: mega-, macro-, micro- and nano -level influencers. Smaller countries like Finland have very few influencers with a following over 1 million. It is important to understand the benefits and shortcomings of each category because it will guide who you choose.

The third section of the guidelines provides concrete steps on how to get started. The section discusses the importance of having a clear strategy, building a long-lasting relationship with the influencer and how to find the right influencer. The section also helps with how to select a social media platform based on who you want to reach and how to create the content for the campaign together with the influencer and how to organise the division of labour. Finally, the section discusses compensation policy, laws regulating influencer marketing, and how to measure impact of a campaign.

The third section also addresses various ethical considerations and risks that come with engaging with influencers. Much like all marketing efforts, public actors should think carefully about the ethical dimensions of their actions. Influencers should not be used to bolster one's image. Compensation arrangements must be assessed on a case by case basis. If a campaign is focusing on awareness raising, one must think about the nature of the issue itself and how to communicate the relevant information in a clear way. Every campaign should be planned to ensure that it causes as little harm as possible and is as accessible as possible.

The guidelines prototype was assessed by risk and crisis communication experts. In general they felt that the role of social media influencers will increase in the future, and there is a need to raise awareness of the collaboration potential. However, it is equally important to understand the risks and ethical concerns. It was also seen as important that the crisis management agencies build themselves a strong social media presence and actively use their digital channels such as websites as a point of reference for citizens. In other words, one has to start from learning the basics in digital communication services and then build partnerships with those individuals, who have already gained a powerful position within these platforms.

More information: Jukarainen P., Mela M., Valsta E., Orru K., Latvakoski J., Lusikka T., Keränen J., Pilsas G., Rhinard M., Kuran C., Gabel F., Berawi M.A., Kajganovic J. and Vrabie C. (2022) D6.6, Stakeholder validation of research findings and co-creation of innovations, BuildERS project report.

5. Technology prospects to improve resilience

5.1 New ways to collect data in disaster situations

Juhani Latvakoski, Jaana Keränen and Toni Lusikka, VTT Technical Research Centre of Finland

5.1.1 Technologies and tools for disaster management

In the BuildERS project, an analysis of technologies and tools (T&T) for disaster management that can help in collecting data on vulnerabilities was carried out. The analysis covered 118 tools developed in 52 European research collaboration projects and revealed large heterogeneity and wide variance in the maturity of tools.

From a technological perspective, the **emergence of smartphones, mobile and satellite access infrastructures and the Internet of Things (IoT)** has created an essential basis for new opportunities for disaster management. Smartphones can capture the geographic location of the user to help locate people affected by disasters. Furthermore, smartphones enable users to communicate in a richer way than basic mobile devices do and to use applications such as social media for rapid exchange of information during a crisis. Thus, the role of smartphones for public safety warnings and emergency communication seem to be essential.

IoT solutions enable taking information from different kinds of sensors attached to people, vehicles, buildings, infrastructures, environment, on the ground etc. Such information streams can even be real-time, which could enable a new level of situational awareness in disasters. In addition to monitoring, new ways to enable control type of operation with cyber-physical systems (CPS) such as unmanned robots (drones etc.) can increase the level of detail which can be obtained from disaster areas. For example, it is estimated that it is possible to enrich satellite images by using images exposed from drone cameras. Advancement in the information sharing via heterogeneous communication channels and cloud computing with storing of big data exposed from different sources has led to possibilities for improving the situational awareness of authorities, but also enlarging it towards NGOs, communities and even ordinary people.

The emergence of social media applications has opened possibilities for new ways for information exposure and sharing between communities of people and organizations. It is estimated that the recent advancement in machine learning/artificial intelligence (AI) will make it possible for decision makers to get help in processing large amounts of information to improve their operations in disasters. For example, it is estimated that increasing the smart processing of satellite images will provide new levels of information granularity exposed from raw image data. The importance of positioning, use of social media, satellite imaging, the Internet of things, use of drones, 5G, AI and blockchain technologies have the potential to improve crisis management in the future. One solution for data integration from various

public data sources was made in the BuildERS project. The Natural Disaster Mapping Tool gathers hazard information from public registries and combines it into one visualization.

When discussing vulnerable people more specifically, an essential challenge arises because most of the tools and new technological opportunities require the use of some physical asset or device such as a smartphone or IoT device. When a vulnerable person is located in a disaster area without such a device or capabilities, it is a real challenge to find that person. The use of crowdsourcing, drones/robots, or imaging with AI may provide some opportunities, however, the application of these technologies for finding such vulnerable people highlights the need for essential information sharing based actions in the preparedness phase. In addition, using smartphones efficiently requires some preceding actions related to application installation, configuration and the skills to use the applications.

The **digital divide** related to the unequal distribution of skills, access to technological means and tools remains an essential future challenge especially for vulnerable people in crises. For example, old people, children, homeless people, and people with limited economical resources are more vulnerable. Thus, issues of fairness and inclusivity need great attention in the application of these technologies in order not to overlook the vulnerable population.

The suspension of vital services such as electrical power cuts during storms (e.g. in recent years in Estonia and Sweden) or the damage to communication infrastructure (telecommunication masts) due to wildfires (e.g. in Portugal and Sweden) indicates the fragility of technological tools in hazardous situations. The failure of essential tools may put services and service users at risk or exacerbate existing vulnerabilities. In any case, the potential of technical solutions to improve operations in different disaster life-cycle phases is so essential that significant investment in research and development is recommended.

5.1.2 End-user evaluations of technologies and tools

The end user evaluations of specific tools were conducted in three case studies in the BuildERS project. A Mobile Positioning Data (MPD) tool with two different dashboards applying location-based services to increase risk awareness were evaluated in two case studies, and the Trasim tool for crisis communications training to improve preparedness was evaluated in another case study. Evaluation in co-creative workshops aimed to evaluate technologies on the following themes: emerging technologies for risk and vulnerability assessments, location-based services, data sharing between authorities, and crowdsourcing for improving preparedness.

When looking at the results, it seems that drones, location-based services, and crowdsourcing are the most preferable technological solutions in crisis management. They were assessed to be the most useful technologies with a lot of innovation potential. They also had more benefits in comparison to their costs, and it was estimated that they could be used widely in crisis management in the near future. On the other hand, technological solutions with the most ethical issues were estimated to be location-based services and artificial intelligence (AI). AI solutions and

crowdsourcing were also estimated to increase or create risks for vulnerable people more than other technologies. Therefore, technological solutions may offer great opportunities to support crisis management, but at the same time, **potential risks and ethical concerns (e.g. discriminatory algorithms, data protection issues) must be carefully considered** not to cause any additional problems for people or society.

Data security was seen as a big concern related to all technologies. It should be ensured that data collected for a certain purpose is not used for any other purposes if not notified beforehand. It should be also very carefully defined who can use the information gathered from people. Data management procedures must be strictly defined, especially what kind of data it is allowed to gather, who manages the data, who can access the data, and where the data is stored. One challenge is that quite often different actors such as authorities operate in separate silos. Silos complicate active data sharing and may slow down evidence-based management in a crisis. There are solutions such as platforms for data sharing, but the problem seems to be they are not yet utilised widely and efficiently enough.

Reliability and lack of data may lead to risks. If ordinary people (i.e. not crisis management experts) participate in data production, risks may occur. People might deliver false information due to their own misunderstandings. They might have hostile intentions, or they might even make jokes. If data is collected by using smartphones, the size of the population with smartphones should be known. Certain individuals who may be a part of populations that are considered vulnerable may not have smartphones, or they may not get information on possible applications they could use to produce data or get help. This may lead to them being excluded when using technology. The involvement of people greatly depends on their capacity to participate. Language barriers or distrust in authorities, for example, could prevent some individuals from participating. It should be ensured that applications are easy to use and inclusive, allowing for individuals who might face communication-related barriers to also use them.

With the fast development of technology and innovative utilisation of technological solutions for new domains it is challenging to keep legislation and regulations up-to-date. Technology offers great opportunities for crisis management, such as the use of drones in disaster areas where rescue personnel have no access. However, the use of technology may violate the privacy of individuals if regulation does not set appropriate codes of action. In addition to regulation, general public acceptance was seen as an issue that has to be taken into account when using technological solutions and services in new ways.

More information: BuildERS reports D2.4 and D6.4. Natural disaster mapping tool, see BuildERS report D3.4.

5.2 Using historical mobile phone positioning data in disaster management

Ago Tominga, University of Tartu

During a disaster situation, it is important for relief workers to have an overview of what is going on: how many people need aid, what kind of help they need and how those needs may change day by day after the beginning of the acute crisis phase. Rescue workers and researchers have tried to retrieve this information with questionnaires, field observations, and even satellite imagery to have reliable information on potential number of people, who are present in the hazard area. These methods are labour demanding. In 2010 Bengtsson et al. (2011) used mobile phone positioning data to evaluate the population presence and movements after the Haiti earthquake. The results were promising, and several similar methodologies have followed (Lu et al. 2012, Wesolowski et al. 2014, Bharti et al. 2015, Jansen et al. 2021).

During the project, we have been aiming to advance mobile phone positioning technologies for disaster management. The Positium, University of Tartu and the Estonian Rescue Board have been working together to create a dashboard showing distributions of population groups in Estonia. The result has been validated during tabletop exercises with external stakeholders.

5.2.1 Why historical mobile positioning data?

One of the goals in the BuildERS project was to create a dashboard for relief workers. The dashboard includes several interactive map layers where relief workers can receive geographical and temporal information on populations and movements. The decision to use historical mobile positioning data has several reasons.

Firstly, the dashboard based on historical data can be detached from Internet and cloud services. This makes it a reliable source of information in any disaster situation—even those where there are power outages and disturbed Internet use. Rescue workers can download the dashboard onto their work laptops and use it everywhere.

Secondly, with historical data we can look into the past, e.g. previous disaster situations and study the mobility effects they had on people. This information is beneficial during tabletop exercises and evacuation planning.

5.2.2 The developed dashboard

The dashboard has three layers. Firstly, the population statistics layer. This shows total populations in different areas in Estonia with either in hourly or daily steps (Figure 12). When a user of the dashboard clicks on an area, a new window appears which shows population changes of local residents, workers, domestic and foreign tourists and transit visitors (Figure 13). Secondly, there is a population movement

layer that shows mobility flows (numbers of people) who commute between respective areas at different times. Thirdly, a secondary home layer shows the number of people within an area who have a second place to go to. Data on secondary homes is aggregated into distance zones, which enables relief workers to see how many people would have to move up to 50 km and how many more than 100 km. This information can be used during evacuation planning, where rescue workers can estimate numbers of people who would need housing and who would not.

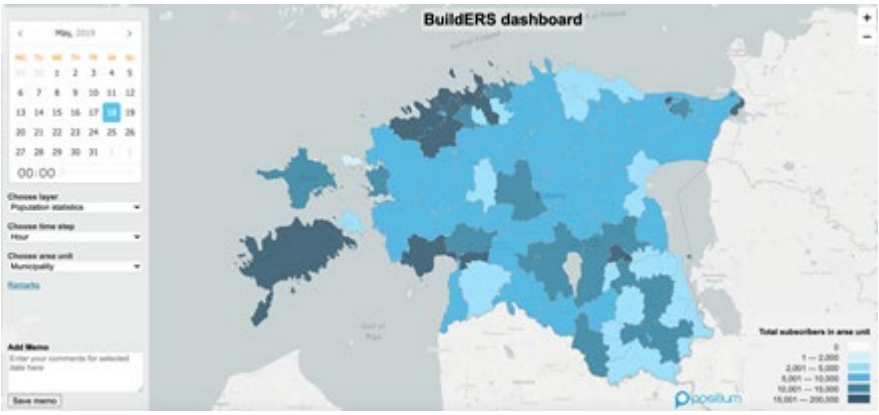

Figure 12. Population statistics layer on 18th of May 2019 midnight with hourly view on municipality level.

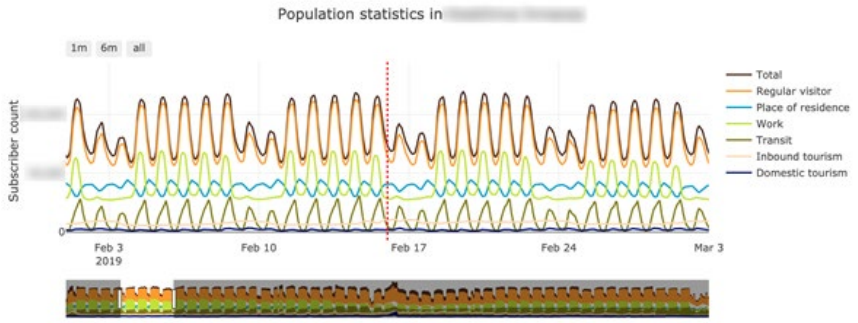

Figure 13. Hourly changes in population counts per subscriber groups in one area. Higher total value is during weekdays and lower values during weekend. Higher values during daytime, lower values during the night-time.

5.2.3 Use potential in disaster management

Most importantly for disaster management, we developed a methodology for the whole process of converting mobile phone positioning data into population statistics.

This methodology can be used to produce official statistics and as mobile phone positioning data is relatively standard, this methodology can be implemented elsewhere as well.

During the tabletop exercises, we discussed the potential use of the dashboard through all cycles of disaster management: mitigation, preparation, response and recovery.

On the one hand using the dashboard in all crisis preparedness phases provides a good additional dataset, but on the other hand, it is also a necessity to give relief workers necessary experience with the dashboard. In the mitigation phase reliable data pipelines should be created, so that the privacy ethics would be covered and the data is accessible. In the preparation phase, crises plans should be made using dynamic population statistics included in the dashboard and emergency exercises should be carried out. We saw that mastering a new technology takes time and only after relief workers are familiar with the dashboard should it be used during the acute crises phase. After a crisis, the tool offers an excellent basis to understand recovery processes, as it can be used to see when the mobility behaviour of people returns to pre-disaster normality.

The positive impacts the dashboard has in disaster management are provided more thoroughly in BuildERS reports D4.3 and D6.6. The dashboard has already proved itself to be ready to be used in Estonia and thanks to our experiences in the BuildERS project, the Estonian Rescue Board and University of Tartu are continuing their cooperation to practically start to implement mobile phone positioning data in evacuation planning of wide-spread emergencies.

More information: BuildERS reports D4.3 and D6.6.

5.3 “Save My Life” application improving resilience and disaster preparedness

Mohammed Ali Berawi, University of Indonesia

As a country located at the meeting point of three tectonic plates (i.e. Indo-Australian, Eurasian, and Pacific plates), Indonesia has a high risk of suffering a natural disaster, such as an earthquake or tsunami, the occurrence of which is unpredictable despite several known indicators. Due to the unpredictable nature of disasters, emergency resource allocation and response planning are challenging tasks that must be addressed accordingly to maximize the survival rate. Furthermore, in Indonesia, the advancement of technology is yet to be fully tapped to help the decision-making process during the disaster response phase. Instead, these crucial decisions are still made without using the information that could be gathered by technological solutions. To address this issue and therefore improve the resilience and disaster preparedness, a series of studies along with a corresponding mobile application called “SaveMyLife” is being developed.

5.3.1 Determining the prioritisation for victims in an earthquake disaster using fuzzy logic and decision tree approach

This study was conducted to determine the victim prioritization framework as the foundation for the development of the SaveMyLife application. This study aimed to determine the variables affecting the safety of victims after an earthquake through a benchmarking study and a number interviews conducted with the stakeholders in disaster management from the National Disaster Management Agency (BNPB), the Indonesian National SAR Agency (BASARNAS) and Indonesia Red Cross. Furthermore, the data obtained from the questionnaire given to related stakeholders was then processed using fuzzy and decision tree methods to obtain fuzzy rules and to classify the victim prioritization framework of the model. In order to determine prioritisation of victims; a fuzzy logic method was used by assessing the degree of membership of each variable affecting the victims' safety. After acquiring the membership degree functions, fuzzy rules were made to determine the relationship between independent and dependent variables.

The results from fuzzy logic and decision tree analyses showed that there is a high accuracy in the decision used to determine the prioritized victims urgently need to be rescued during the emergency response phase of a disaster.

5.3.2 Optimizing search and rescue personnel allocation in a disaster emergency response using fuzzy logic

This study presents a decision-making model that assists search and rescue teams in determining the number of personnel to deploy after the occurrence of a disaster, according to the area, population density, equipment, and the number of high buildings. These variables are processed using a fuzzy expert system and a decision tree, in which the data and knowledge acquired as a reference were obtained from disaster management stakeholders as well as experienced practitioners in the field of search and rescue.

The result of an accuracy test performed on the developed prioritization model showed that the classification accuracy was more than 80%. The input processing carried out by the Fuzzy Inference System (FIS) was also fast, indicating that it is able to prevent obstacles when managing emergency responses for a disaster. A simulation was conducted on the developed model by using an area of 3 km^2, a population density of 1,000 people/km^2, and a building density of 7/km^2 as a case study. With an average equipment completeness of 80% for the available personnel to be deployed, it indicated that 126 personnel could to be deployed to respond to the disaster.

5.3.3 Increasing the disaster victim survival rate: SaveMyLife mobile application development

A disaster related mobile application titled SaveMyLife was developed based on the result of a previously conducted scientific study (Berawi et al. 2019; Berawi et al.

2020; Berawi et al. 2021). It aims to improve search and rescue team response times and increase the victim survival rate by considering the victim vulnerability prioritization and technology utilization. The application has three main features: preloaded content, a panic button, and early warning system, functioning as both preventive and corrective actions in the pre-disaster and disaster stages.

The preloaded content is a feature that enables the application to process data and information based on preloaded resources that have been installed beforehand. This feature enables the application to run smoothly without heavily relying on an Internet connection. There are two sub-features in the preloaded content, including safety points that will assist users in finding shelters or assembly points during disaster event and safety tips. With the safety points feature, the application will assess the type of buildings (police offices, hospitals, mosques, and fire stations) that can be used as evacuation centres by taking into account three criteria: the least impact from the disaster, direct access to a primary road, and a minimum building size of 225m^2. The application informs users of safety points as follows:

- When the application is opened, the map feature will immediately display the evacuation points within proximity of the user.
- The application will retrieve the coordinates of the evacuation points.
- The application will display the addresses and estimate the time to reach these evacuation points from the user's position.

Meanwhile, the safety tips feature contains precautions to inform users regarding the potential risks and threats of a disaster. It attempts to improve public awareness of disasters and emergency events by providing educational videos from YouTube ranging from how-to first aid to activities before, during, and after the occurrence of disasters.

The preloaded content provides users with information related to the nearest safety points from the user's location, the estimated time required to reach the safety points (e.g. police station, local hospital, mosque, community center, etc.), and also real-time information about the disaster given by official authorities (Figure 14).

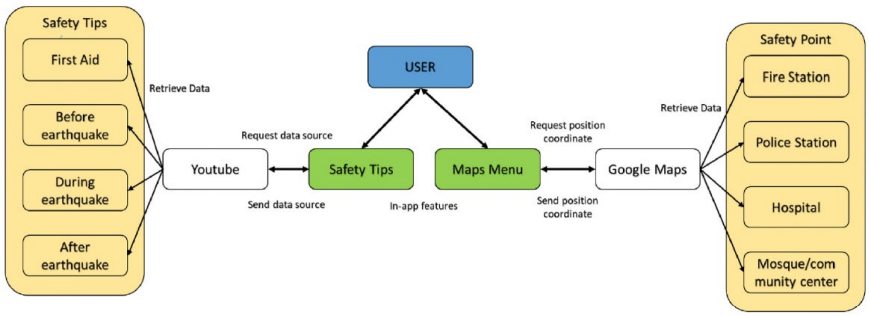

Figure 14. Workflow Diagram of Safety points and Safety Tips Features.

The panic button feature (Figure 15) provided by the system enables the user to notify the rescue team of their condition during an emergency. When a victim taps the panic button, the rescue team can accurately determine their location, enabling them to prepare appropriate aid or treatment plans for the victims effectively. Based on user information, such as age, special needs, and health status, provided upon registration, the algorithm automatically categorizes the users into groups, thereby allowing vulnerable individuals (e.g. people with disabilities, pregnant women, children, the elderly, people with underlying medical conditions) to be identified accurately.

As for the early warning function, the application provides a real-time alert of information regarding disasters, particularly earthquakes, with the location details and magnitude. The information presented about the earthquake is taken from the InaSAFE.org website, a free software program jointly developed by BNPB, the Australian government, and the World Bank, providing insights into the impact of future disaster events by combining data from governments, scientists, and communities

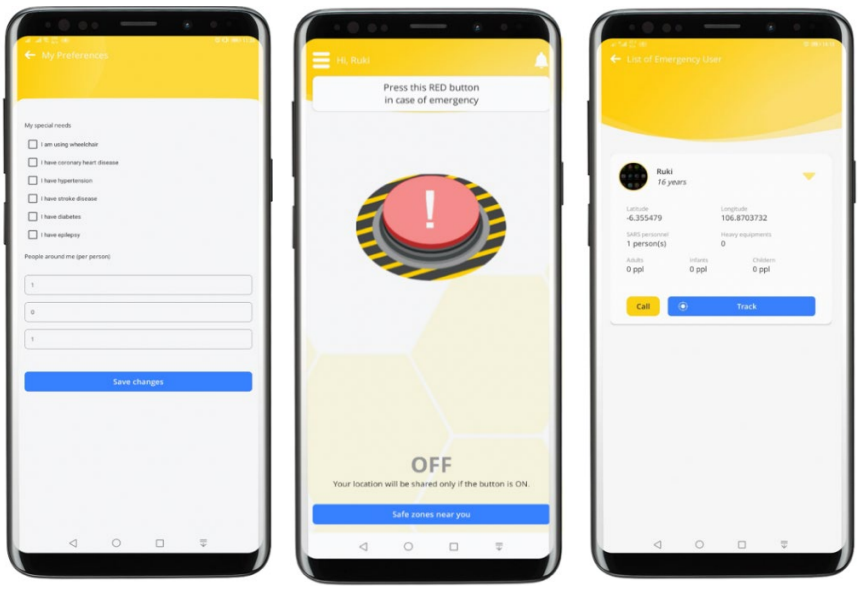

Figure 15. User interface of SaveMyLife Application.

More information: the SaveMyLife application bit.ly/SaveMyLifeDemo.; Berawi et al. 2021. Increasing disaster victim survival rate: SaveMyLife Mobile Application development; Berawi et al. 2020. Determining the Prioritized Victim of Earthquake Disaster Using Fuzzy Logic and Decision Tree Approach; Berawi et al. 2019. Optimizing Search and Rescue Personnel Allocation in Disaster Emergency Response Using Fuzzy Logic.

5.4 Recommendations on resource allocation for addressing risks

Tommaso Piseddu, Stockholm Environment Institute

The framework developed to provide recommendations to policymakers, first responders and all the other actors involved in disaster risk management is built starting with the recognition of the several flaws that might characterise cost-benefit analyses when applied to the field of disaster risk management. From an ethical perspective, assigning monetary values to saved lives could be judged to be morally unacceptable. From a practical point of view, modelling the probabilities of disasters occurring could be extremely challenging and the previous literature on the topic has shown how that given the nature of low-frequency and high-impact events, only limited databases are available, containing few observations. These types of uncertainties in the modelling of the probability of a disaster can potentially bias the whole analysis.

To account for these issues, the development of a framework to guide investment decisions concerning disaster risk management tools and technologies has been carried out in two directions. On the one hand, the necessary investments were estimated using a life-cycle cost approach (LCC), meaning that all the possible costs and expenditure that may arise during the deployment of each tool were accounted for. These were then discounted to present values following the standard approach in the economic literature. The necessity to do this comes from the understanding that some tools might require a small initial investment but may need expensive operational and maintenance activities. The LCC approach allows us to account for all these potential costs, from the initial investment to the disposal costs that emerge at the end of the tool's operational life. On the other hand, we carried out a benefits assessment of each individual tool. This evaluation was carried out through the involvement of stakeholders: academia, first responders, members of national and international authorities and actors from private businesses were invited to join and provide their insights. The responders were asked, through an online survey, to state their degree of agreement with 15 questions that investigated the potential benefits each tool might bring to its users. These 15 questions were developed in accordance with the BuildERS project's focus and framework and were grouped under five main topics: risk awareness, social capital, preparedness, feasibility, and acceptability. In total, we have been able to collect 116 replies. The tools under analysis were those that had already been investigated extensively in the project by other partners.

Once the necessary data on the costs and benefits were collected, we proceeded with an analysis. The scores assigned to the beneficial aspects through the survey were normalized to make them comparable. The final step of the analysis concerned the production of cost-benefit ratios. Producing the ratios between the costs and the benefits, that is, dividing the LCC measures by the normalized scores each tool received under the benefits analysis allowed us to make the results comparable, easier to understand and more complete. The cost-benefit ratios can shed light on

how expensive the investment is for the tools while also accounting for the potential benefits that they can return. The figures are then easily comparable and ready to be shared in an intuitive graphic way.

Recognizing that costs and benefits cannot be the only factors to be considered when evaluating investment alternatives, we carried out a literature review on the potential barriers, in terms, for example of limiting legislation that may arise when deploying the tools. The literature review also allowed us to provide comments on what to expect in terms of future developments and improvements in the industry of the tools. How, for instance, will new technological solutions such as 5G and blockchain be able to contribute to the further development of the tools. The best form of provision was also investigated, accounting for the many potential alternatives that are available when public authorities access these services and tools. The literature review was also supported by ten interviews that we conducted with experts on the tools and technologies to validate our findings.

In our minds, the application of these cost-benefits ratios as they were developed within the project should constitute an example to support practitioners in their decision making in real life rather than actual results. The figures and the results we present should not and cannot be generalized to every context and every situation. First of all, disaster risk management is a field that is extremely case and context sensitive. An investment decision should take into consideration the socioeconomic, environmental and infrastructural characteristics of the areas in which the technologies and the tools will be used. From the cost perspective, the heterogeneity in costs factors across the world does not make our figures applicable everywhere. We tried to focus, as much as possible, on a Scandinavian perspective, mainly referring to the Swedish market. The framework is extremely flexible but the collection of data on costs, benefits, potential barriers and stakeholders' opinions should always reflect the characteristics of the area of application.

More information: BuildERS report D5.4 Recommendations on resource allocation for addressing risks.

6. Conclusions

Jaana Keränen, VTT Technical Research Centre of Finland

The BuildERS project (2019-2022) has developed knowledge and insights to improve resilience in society. This has been done, in particular, focusing on the ability and capacity of the most vulnerable to be prepared and respond to disasters, improving and supporting their capacity to act will develop the society as a whole to be prepared and respond to natural and man-made disasters. Thus, the societal resilience of European communities will improve.

In the BuildERS project, it has become clear that the concept of vulnerability is not straightforward; it changes depending on the situation and is dynamic in its nature. Anyone can be vulnerable at a certain point of time and place. However, there are people who have a higher or very high risk of being vulnerable in certain situations. For example, people who do not have permanent housing are often more vulnerable than others in disasters. Among the homeless who are considered to be vulnerable, there are people who are seen to be even more vulnerable. They are, for example, homeless who are lonely without any social support or those who suffer from addiction problems. This became evident in a survey conducted with clients of the Salvation Army in 2020-2021. During the survey, Europe and the whole world were battling the COVID-19 pandemic. The pandemic situation underlined the distress of vulnerable people and indicated the intersectional nature of vulnerability, namely that vulnerability can be an extreme experience without a decent home and when social care services are shut down due to lockdown restrictions.

The BuildERS project has progressed from an early stage of scientific research to a more applied one. At the beginning of the project, a framework for resilience used in the project was developed, describing the connections with the key concepts in the crisis management process. From the point of view of the BuildERS project, key concepts included in the framework were vulnerability, social capital, and risk awareness. Through the research results and findings, vulnerability in disasters has been understood in a more nuanced, intersectional and situational manner. There are a variety of differences between people who are considered to be vulnerable, which are important to comprehend. To build functional ways to improve and support societal resilience before, during and after disaster, it is essential that actors realize a broad perspective of potential characteristics of vulnerability.

In the BuildERS project, a range of practical solutions to support disaster management actors (such as authorities and practitioners such as care providing organisations and non-profit organisations) in assessing vulnerabilities and supporting vulnerable people have been developed. Some of the tools or guidelines have already been further developed and are more advanced, some are more in the concept stage. However, all the tools help to assess different aspects of vulnerability, build new knowledge, or establish various forms of collaboration. It is important to note that the tools have been developed in collaboration with various stakeholders.

We have received valuable insights and assessments of the usability and usefulness of the tools during the development process. Many tools and guidelines have also been field-tested, piloted or simulated to enable their applicability and transferability to different use cases. The tools are assembled together in the so-called BuildERS Toolbox for inclusive crisis management that builds the resilience of the whole of society.

A wide range of policy recommendations have been made to reduce vulnerability, build social capital, and raise risk awareness of the European population. As already stated earlier, vulnerability, as well as social capital and risk awareness have multiple meanings and multifaceted characters and therefore can be improved through multiple actions. Based on research results and findings, policy recommendations include key actions and new ways of working towards a more resilient society. The BuildERS project policy recommendations include several key actions for both authorities and practitioners on different levels (EU, national and local level actors). These, together with the tools and guidelines developed, provide guidance on what to do and how to act to help prepare and respond to disasters.

Ethical issues in especially co-creation activities with stakeholders have been an essential part of the research and activities during the project. In the BuildERS project, potential ethical topics and issues that need to be considered in different processes were created as a set of questions, which have been used to support and guide collaboration with stakeholders. The results and lessons of ethics consideration have already been shared with other EU-funded projects focusing on resilience research, where they have been successfully exploited.

The research consortium of the BuildERS project has consisted of research institutes, universities, companies, and end-users such as authorities and representatives of non-profit organisations. Over the past three years, the BuildERS project has developed results in collaboration with a wide range of stakeholders. With our Stakeholder Forum, we have collaborated with hundreds of experts. They have represented both public, non-profit, and private sectors. This variety of views and experiences has made diverse discussion and reflection possible, which has naturally helped us to develop better results.

We have produced a wide range of different innovations such as tools and guidelines as well as policy recommendations over the last three years. In addition, the project has produced a large amount of knowledge, e.g. public reports describing the results of the project are available on the project website https://buildersproject.eu/. Public reports are also available on the EU platforms: https://ec.europa.eu/info/funding-tenders/opportunities/portal/screen/opportunities/horizon-results-platform and https://cordis.europa.eu/. Scientific papers directed more to the academic community are also available on the BuildERS website. All scientific papers are so-called open access documents—they are distributed online, free of access charges or other barriers.

References

Ammicht Quinn, R. 2014. Sicherheitsethik. Eine Einführung. In: Regina Ammicht Quinn (Hg.): Sicherheitsethik. Wiesbaden: Springer VS (Studien zur inneren Sicherheit, 16), S. 15–50.

Bengtsson, L., Lu, X., Thorson, A., Garfield, R., von Schreeb, J. 2011. Improved Response to Disasters and Outbreaks by Tracking Population Movements with Mobile Phone Network Data: A Post-Earthquake Geospatial Study in Haiti, PLoS Medicine 8(8): e1001083. DOI: 10.1371/journal.pmed.1001083

Berawi et al. 2021. Increasing dis-aster victim survival rate: SaveMyLife Mobile Application development

Berawi et al. 2021. Increasing disaster victim survival rate: SaveMyLife Mobile Application development

Berawi et al. 2020. Determining the Prioritized Victim of Earthquake Disaster Using Fuzzy Logic and Decision Tree Approach

Berawi et al. 2019. Optimizing Search and Rescue Personnel Allocation in Disaster Emergency Response Using Fuzzy Logic.

Bharti, N., Lu, X., Bengtsson, L., Wetter, E., Tatem, A. 2014. Remotely measuring populations during a crisis by overlaying two data sources. International Health 7(2), pp 90-98, DOI: 10.1093/inthealth/ihv003

Busch-Geertsema, V., Culhane, D., & Fitzpatrick, S. (2016). Developing a global framework for conceptualising and measuring homelessness. Habitat International, 55, 124–132. DOI: 10.1016/j.habitatint.2016.03.004

Council of the European Union. 2020. Council conclusions on strengthening resilience and countering hybrid threats, including disinformation in the context of the COVID-19 pandemic, 15 December 2020, 14064/20. https://data.consilium.europa.eu/doc/document/ST-14064-2020-INIT/en/pdf

De Keersmaecker, J. & Roets, A. 2017. 'Fake news': Incorrect, but hard to correct. The role of cognitive ability on the impact of false information on social impressions, Intelligence, 65, 107-110. Online version of the article.

Enke, N. & Borchers, N. S. 2019. Social Media Influencers in Strategic Communication: A Conceptual Framework for Strategic Social Media Influencer Communication, International Journal of Strategic Communication, 13(4), 261-277, online version of the article

European Commision. 2018. “Communication from the Commission to the European Parliament, the Council, the European Economic and Social Committee and the Committee of the Regions. Tackling online disinformation: a European approach", COM (2018) 236 final, 26 April 2018, Brussels. https://ec.europa.eu/info/sites/info/files/eu-communicationdisinformation-euco-05122018_en.pdf

European Parliament. 2012. Charter of Fundamental Rights of The European Union. 2012/C 326/02. Online verfügbar unter https://eur-lex.europa.eu/legal-content/EN/TXT/?uri=CELEX:12012P/TXT.

Gabel, F. 2019. Chancen dynamischer Konzeptionen von Vulnerabilität für den Katastrophenschutz, In: Marco Krüger und Matthias Max (Hg.): Resilienz im Katastrophenfall. Konzepte zur Stärkung von Pflege- und Hilfsbedürftigen im Bevölkerungsschutz, 1. Auflage, Bielefeld: transcript (Gesellschaft der Unterschiede, 46), S. 77–96.

Geale, S. K. 2012. The ethics of disaster management. In: Disaster Prev and Management 21 (4), S. 445–462. DOI: 10.1108/09653561211256152.

GFDRR. 2018. Five actions for disability-inclusive disaster risk management, Global Facility for Disaster Risk Reduction: Washington.

Hansson, S., Orru, K., Siibak, A., Bäck, A., Krüger, M., Gabel, F., Morsut, C. 2020. Communication-related vulnerability to disasters: A heuristic framework. International Journal of Disaster Risk Reduction, 51, 101931. DOI: 10.1016/j.ijdrr.2020.101931.

Hansson, S., Orru, K., Torpan, S., Bäck, A., Kazemekaityte, A., Meyer, S. F., Ludvigsen, J., Savadori, L., Galvagni, A., Pigrée, A. 2021. COVID-19 information disorder: six types of harmful information during the pandemic in Europe. Journal of Risk Research, 24:3-4, 380-393, DOI: 10.1080/13669877.2020.1871058.

Jadad, A. R., & O’grady, L. 2008. How should health be defined?. Bmj, 337.

Jansen, R. Kovacs, K., Esko, S., Saluveer, E., Sõstra, K., Bengtsson, L., Li, T., Adewole, W., Nester, J., Arai, A., Magpantay, E. 2021. Guiding Princi-ples to Maintain Public Trust in the Use of Mobile Operator Data for Pol-icy Purposes. Data & Policy 3. DOI: 10.1017/DAP.2021.21.

Krüger, M., Gabel, F. 2021. From Lisbon to Sendai: Responsibilities in International Disaster Management. In: Hannes Hansen-Magnusson und Antje Vetterlein (Hg.): The Routledge Handbook on Responsibility in International Relations. pp. 203-216, London, New York: Routledge.

Kuran C. H. A., Morsut C., Kruke B. I., Krüger M., Segnestam L., Orru K., Naevestad T. O., Airola M., Keränen J., Gabel F., Hansson S., Torpan S. 2020. Vulnerability and vulnerable groups from an intersectionality perspective, International Journal of Disaster Risk Reduction, Volume 50, verfügbar unter: DOI: 10.1016/j.ijdrr.2020.101826Lancet, T. 2009. What is health? The ability to adapt. The Lancet, 373(9666), 781.

Lancet, T. 2009. What is health? The ability to adapt. The Lancet, 373(9666), 781.

Lu, X., Bengtsson, L., Holme, P. 2012. Predictability of population displacement after the 2010 haiti earthquake. Proc Natl Acad Sci USA 109, 11576–81

Matei, V., Pavel, A., Giurgiuca, A., Rosca, A. Sofia, A., Dutu, I. Tudose, C. 2020. Knowledge of prevention measures and information about coronavirus in Romanian male patients with severe mental illness and severe alcohol use disorder, Neuropsychiatric Disease and Treatment, 16, 2857-2864.Online version of the article

Morsut, C. et al. 2020. *D1.3: Report on segments of vulnerability country by country basis – inside and outside the official data*. BuildERS Report

Morsut, C. et al. 2020. *D1.2 Final report of the unified theoretical framework on the concepts of risk awareness, social, capital, vulnerability, resilience and their interdependencies*. BuildERS Report.

Morsut, C., Kuran, C., Kruke, B. I., Orru, K. and Hansson, S. 2021. Linking resilience, vulnerability, social capital and risk awareness for crisis and disaster research. *Journal of Contingencies and Crisis Management* DOI: 10.1111/1468-5973.12375.

Nævestad, T.-O. et al. (under review) Self-inflicted social isolation among clients of social care organisations in the COVID-19 Pandemic, under review in the International Journal of Disaster Risk Reduction.

Nævestad, T.-O. et al. (submitted). Psychological impacts for socially marginalised groups in the COVID-19 Pandemic: A Study from European countries, under review in the European Journal of Social work.

Nero et al. (under preparation). Mechanisms behind COVID-19 scepticism among marginalised groups in Europe, to be submitted to Risk Research.

Olson et al. (under preparation). The Impact of Covid-19 on Migrant and Refugee Populations in Europe: Insights from 13 Countries.

Orru, K., Klaos, M., Nero, K., Gabel, F., Hansson, S., Naevestad, T-O. (under review) “Imagining and assessing future risks: A dynamic scenario-based

social vulnerability analysis tool for disaster planning and response" in Journal of Contingencies and Crisis Management.

Orru, K.; Nero, K., Nævestad, T-O., Schieffelers, A., Olson, A., Airola, M., Kazemekaityte, A., Lovasz, G., Scurci, G., Ludvigsen, J., de los Rios Pérez, D. A. (2022). Resilience in care organisations: challenges in maintaining support for vulnerable people in Europe during the Covid-19 pandemic. Disasters. DOI: 10.1111/disa.12526.

Orru, K., Hansson, S., Gabel, F., Tammpuu, P., Krüger, M., Savadori, L., Meyer, S. F., Torpan, S., Jukarainen, P., Schieffelers, A., Lovasz, G., Rhinard, M. 2021. Approaches to 'vulnerability' in eight European disaster management systems. Disasters, https://onlinelibrary.wiley.com/doi/10.1111/disa.12481.

Pieper, A. 2007. Einführung in die Ethik. 6., überarb. und aktualisierte Aufl. Tübingen, Basel: A. Francke (UTB, 1637).

Schouten, A. P., Janssen, P., Verspaget, M. 2019. Celebrity vs. Influencer endorsements in advertising: the role of identification, credibility, and Product-Endorser fit, International Journal of Advertising, 39 (2), 258-281. DOI: 10.1080/02650487.2019.1634898

Shuster, E. 2014. Interests Divided: Risks to Disaster Research Subjects vs. Benefits to Future Disaster Vitctims. In: Dónal P. O'Mathúna, Bert Gordijn und Mike Clarke (Hg.): Disaster Bioethics: Normative Issues When Nothing is Normal. Dordrecht: Springer Netherlands (Public health ethics analysis), S. 109–127.

Siimsen, I., Orru, K., Naevestad, T.-O., Nero, K., Olson, A. (under review). Material impacts of the pandemic on the marginalised: Covid-19 as the final push to health-poverty trap? Journal of Crisis and Contingencies Management.

Southwick, S., Bonanno, G., Masten, A., Panter-Brick C., Yehuda, R. 2014. Resilience definitions, theory, and challenges: Interdisciplinary perspectives. *European Journal of Psychotraumatology* 5(1), 25338, DOI: 10.3402/ejpt.v5.25338.

Torpan, S., Hansson, S., Rhinard, M., Kazemekaityte, A., Jukarainen, P., Meyer, S. F., Schieffelers, A., Lovasz, G., Orru, K. 2021. Handling false information in emergency management: A cross-national comparative study of European practices. International Journal of Disaster Risk Reduction, 57, 102151. DOI: 10.1016/j.ijdrr.2021.102151.

UN United Nations. 2015. Sendai Framework for Disaster Reduction 2015-2030. Resolution A/RES/69/283 by the United Nations General Assembly. Dated 23 June 2015.

UNISDR. 2017. UNDRR Terminology: Disasters. Online verfügbar unter https://www.unisdr.org/we/inform/terminology.

UNISDR. 2015. The Sendai Framework for Disaster Risk Reduction 2015-2030, Third UN World Conference in Sendai, Japan, March 18, 2015, The United Nations Office for Disaster Risk Reduction. Sendai Framework for Disaster Risk Reduction 2015 - 2030 - PDF

Wesolowski, A., Buckee, C., Bengtsson, L., Wetter, E., Lu, X., Tatem, A. 2014. Commentary: Containing the Ebola Outbreak - the Potential and Challenge of Mobile Network Data. PLoS Currents 2014, DOI: 10.1371/currents.outbreaks.0177e7fcf52217b8b634376e2f3efc5e, https://www.ncbi.nlm.nih.gov/pmc/articles/PMC4205120/

Wisner, B., Blaikie, P., Cannon, T., Davis, I. 2004. At risk. Natural hazards, people's vulnerability and disasters. 2. ed. London u.a.: Routledge.WHO. 2006. Constitution of the World Health Organization. https://www.who.int/governance/eb/who_constitution_en.pdf

Zack, N. 2011. Ethics for disaster. First paperback edition. Lanham: Rowman & Littlefield Publishers, Inc (Studies in social, political, and legal philosophy).

WHO. 2006. Constitution of the World Health Organization. https://www.who.int/governance/eb/who_constitution_en.pdf

Zack, N. 2011. Ethics for disaster. First paperback edition. Lanham: Rowman & Littlefield Publishers, Inc (Studies in social, political, and legal philosophy).

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Title	**Handbook to improve societal disaster resilience—BuildERS project findings.**
Author(s)	Jaana Keränen (ed.)
Abstract	This handbook introduces the results of the BuildERS research project. The Build-ERS project (2019-2022) has developed knowledge and insights to improve resili-ence in society. This has been done, in particular, focusing on the ability and capaci-ty of the most vulnerable to be prepared and respond to disasters. Improving and supporting their capacity to act will develop society as a whole to be prepared and respond to natural and man-made disasters. Thus, the societal resilience of Europe-an communities will increase. In the BuildERS project, it has become clear that the concept of vulnerability is not straightforward; it changes depending on the situation and is dynamic in its nature. Anyone can be vulnerable at a certain point of time and place. However, there are people who have a higher or very high risk of being vulnerable in certain situations. A range of practical solutions have been developed to support disaster management actors in assessing vulnerabilities and supporting vulnerable people, and improving the resilience of society against crises. These tools and guidelines help to assess different aspects of vulnerability, build new knowledge, or establish various forms of collaboration. A wide range of policy recommendations have been made to reduce vulnerability, build social capital, and raise risk awareness of the European population. Based on the research results and findings, the policy recommendations include key actions and new ways of working towards a more resilient society. BuildERS Policy recom-mendations include several key actions for both authorities and practitioners on dif-ferent levels: EU, national and local. These together with the tools and guidelines developed provide guidance on what to do and how to act to help preparedness and respond to disasters.
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Tekijä(t)	Jaana Keränen (toim.)
Tiivistelmä	Tämä julkaisu esittelee BuildERS-tutkimushankkeen tulokset. BuildERS-hanke (2019-2022) on tuottanut tietoa ja näkemyksiä yhteiskunnan resilienssin parantamiseksi. Hanke on keskittynyt ennen kaikkea heikoimmassa asemassa olevien kykyyn varautua ja toimia häiriötilanteissa. Heidän toimintakykynsä parantaminen ja tukeminen kehittää koko yhteiskunnan varautumista ja toimimista sekä luonnononnettomuuksissa että ihmisen aiheuttamissa hätätilanteissa. Siten yhteisöjen resilienssi häiriötilanteissa kasvaa. BuildERS-hankkeessa on käynyt selväksi, että haavoittuvuuden käsite on monimutkainen; se vaihtelee tilanteen mukaan ja on dynaaminen luonteeltaan. Kuka tahansa voi olla haavoittuva tietyllä hetkellä tietyssä paikassa. On kuitenkin ihmisiä, joilla on suurempi tai erittäin suuri riski olla haavoittuvia. Haavoittuvuuden arviointia varten sekä haavoittuvien ihmisten tukemiseen ja yhteiskunnan resilienssin parantamiseen on kehitetty erilaisia käytännön ratkaisuja. Nämä työkalut ja ohjeet auttavat arvioimaan haavoittuvuutta eri näkökulmista, keräämään uutta tietoa ja rakentamaan yhteistyön erilaisia malleja. Haavoittuvuuden vähentämiseksi, sosiaalisen pääoman rakentamiseksi ja väestön riskitietoisuuden lisäämiseksi on annettu erilaisia poliittisia suosituksia. Politiikkasuositukset sisältävät keskeisiä toimenpide-ehdotuksia ja uusia tapoja toimia yhteiskunnan resilienssin parantamiseksi. BuildERS-politiikkasuositukset sisältävät toimenpide-ehdotuksia sekä viranomaisille että muille toimijoille eri toimijatasoilla: paikallisella ja kansallisella tasolla sekä EU-tasolla. Toimenpide-ehdotukset yhdessä BuildERS-hankkeessa kehitettyjen työkalujen ja ohjeiden kanssa tukevat varautumista sekä toimintaa häiriötilanteissa.
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