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Terje Gjørseter · Jaziar Radianti ·
Yuko Murayama
Editors


Information Technology in Disaster Risk Reduction

7th IFIP WG 5.15 International Conference, ITDRR 2022
Kristiansand, Norway, October 12–14, 2022
Revised Selected Papers

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Preface

The role of information and communication technology (ICT) in disaster situations is becoming more important than ever in these recent years, especially to mitigate and reduce the risks associated with the effects of disasters. Disaster risk reduction (DRR) is the concept and practice of reducing disaster risks through systematic efforts to analyze and reduce the causal factors of disasters (UNESCO). DRR also has been laid out in the United Nations Sendai Framework for Disaster Risk Reduction 2015–2030, which aims to reduce human loss and affected people in a disaster globally, and to reduce direct economic loss and damage to critical infrastructure and disruption of basic services.

Information and communication technologies offer numerous capabilities that were unimaginable before. The Covid-19 pandemic is a case where society turned to ICT to ensure that mission critical operations required by citizens were sustained, and basic service disruptions could be avoided. Multiple countries should work rapidly together to employ every means to prevent new risks from emerging, to reduce on-going disaster risk, and to manage residual risk. Multi-disciplinary scholars have contributed various methods and empirical and theoretical studies on the role of ICT in disaster risk reduction. For example, they discuss the role of ICT in sustainable disaster management, enabling ICT to support community monitoring of hazard and vulnerability, and governance in a flood context, early warning, mobile alerts, and mobile apps in general, the use of geographical information systems (GIS) and Remote Sensing, and applying data integration and data science from the perspective of disaster risk reduction.

IT and ICT have also been studied as enablers to acquire critical information to achieve a common understanding and situational awareness among the various stakeholders involved in responding to the crisis, and to save lives and property. Modern information and communication technologies can significantly facilitate decision-making processes and thus help to reduce the consequences of disasters.

The Seventh IFIP WG5.15 Conference on Information Technology in Disaster Risk Reduction (ITDRR 2022), held during October 12–14, 2022, at the University of Agder, Kristiansand, Norway. Due to the risk of further outbreaks of the Covid-19 pandemic, ITDRR 2022 was held in hybrid format, with 45 participants: 34 on-site and 11 on-line.

The conference focused on ICT aspects of the challenges in disaster risk reduction. The main topics included areas such as: information analysis for situation awareness, evacuation, rescue, Covid-19 issues, risk assessment, and disaster management.

ITDRR 2022 invited experts, researchers, academicians, and all others who were interested in disseminating their work to attend the conference. The conference established an academic environment that fostered the discussion and exchange of ideas among different levels of academic, research, business, and public communities.

The Program Committee received 33 paper submissions, out of which 23 research papers were finally accepted. The papers have passed through a thorough single-blind

review process. First each paper was assigned to three or four PC members through bidding, allowing them to review papers that were close to their main competence, expertise, and interests. Conflicts of interests were marked since the beginning to accommodate PC members that are also authors. Second, the reviewers provided scores and recommendations for acceptance or rejection. Third, the PC chairs reviewed all feedback from the reviewers, and discussed which decision to reach for any borderline papers.

These 7th IFIP WG 5.15 ITDRR proceedings comprise 23 articles, and 8 sections: Strategic disaster risk reduction; situational awareness; telecommunications, sensors, and drones; collaborative emergency management; cybersecurity and privacy; earthquake and climate forecasting; social media analytics; and community resilience.

Eden and Gonzalez's paper is a keynote speaker's article that addresses the challenges for understanding systemic risks in our complex, interconnected world. The authors suggest a novel approach and method for impactful risk assessment through a causal mapping technique that fulfills transparency and relevant requirements in relation to the experts and the power brokers, i.e., those who have power to act.

In the *situational awareness* section, *Polikarpus et al.* conduct a study on Effective Command and the dynamic decision-making assessment methodology as a theoretical framework for SA assessment and implementation of virtual reality software using sixteen different virtual simulations in an organization. *Bu Daher et al.* propose an ontology that enables the integration, data sharing to various involved actors, and updating of flood-related data in real time during a disaster. The authors underpin how the proposed approach improves both the information interoperability and evacuation priority judgement. *Ogbonna et al.* show the importance of universal design principles in designing rescue applications by emphasizing the presence of situational disabilities and accessibility barriers, based on a Nigerian flooding case. *França et al.* applied six awareness criteria to improve the so-called "Drones to Rescue" in a survey conducted among emergency management stakeholders. The authors also specify some suggestions when using drone operations to actually contribute to enhancing the situational awareness.

Under the *telecommunications, sensors, and drones* section, the authors provide examples of innovative technologies that can help to mitigate disasters. *Soshino's* paper discusses the application of fuel cell vehicles to support ICT in Emergency Response. Such a vehicle has embedded functions such as telecommunication and power supply functions and real-time image sharing, as well as the vehicle management applications that were tested. The author concludes that such a fuel cell vehicle is considered a practical solution to support ICT services in emergency management. *Basu et al.* addresses the Covid-19 Sāvdhān platform that exploited the telecom infrastructure to improve the pandemic management in India. This platform allows for SMS dissemination of pandemic-related messages to the geo-targeted population ranging from information about vaccination, quarantine facilities, testing centers, hotspots, lockdown, supplies, and the dynamic of the Covid 19-related regulations. *Fujita and Hatayama* develop an automated model to detect collapsed buildings that can be applied in earthquake scenarios using multiple object tracking (MOT) from aerial videos. The authors point out the failures in previous studies to detect collapsed buildings using the features of debris or damage in terms of discriminating the

collapsed and standing buildings that have traditional Japanese features, and successfully applied the deep learning MOT model. *Seböck et al.* report a study concerning the challenges and success factors for implementing a chemical, biological, radiological, and nuclear (CBRN) City Sensor Network. The project addresses the idea of deployment of sensor networks to achieve early, automatic detection, identification, and protection against attacks with CBRN substances in public enclosed spaces.

Three articles are included under *the collaborative emergency management* section. *Pilemalm et al.* apply a user-centric approach in identifying and designing information systems support for collaborative emergency management, using Norway as a case. The study describes how it moves from needs to requirements to design proposals and covers core elements of the common operational picture needed for shared situational awareness and the artifacts produced through these processes. *Agray and Meesters'* main concern is the increased complexity of crises, requiring more diversity of the actors, which in turn can affect the quality and variety of information systems, presenting certain risks during a crisis response. A serious gaming research method highlights the increased cybersecurity risks associated with the use of information technologies during a crisis response and identifies the need for increased awareness, cultural change, and additional capacities to mitigate these risks. *Dokas et al.* discuss the interruption during the construction of the Risk and Resilience Assessment Centre project of Eastern Macedonia and Thrace, due to the plane crash of an Antonov An-12 in Kavala, Greece. This triggered the activation of the center to provide decision support expertise and led to a successful collaboration between researchers and stakeholders. *Ben Amara et al.* address a business continuity robustness assessment approach through sociological indicators. This research work aims to define the pillars of a BCM, propose a BCM robustness assessment grid, and introduce sociological indicators to assess the robustness of the BCM.

The *cybersecurity and privacy* section contains three articles. *Stassen et al.* focus on the dilemma between compliance and pressure, and through a serious game, examine human behavior to improve cybersecurity in natural disasters. The study identifies variables such as time, cognitive load, disruption, coordination, and trust that influence compliance rates. *Andreassen et al.* conduct a study aiming to develop an understanding of the concept of situational awareness and its function in Managed Security Service Providers (MSSPs) cyber-incident response operations, and to illustrate best practices in security operations teams. The empirical findings are based on best practices adopted by MSSPs operating in Norway. *Barrios et al.* address the privacy by design challenges in the CBRN (Chemical, Biological, Radiological, Nuclear) technologies for preparedness and response, highlighting the management of vulnerable groups' data. The paper discusses issues related to accessibility and consent to enforce privacy rights, and also assesses the integration of privacy-by-design into the developed platform called "Proactive".

Two of the ITDRR articles are about *earthquake and climate forecasting*. *Nasution et al.* suggest a novel approach to representing locations on the earth called Single Value Coordinate System (SVCS), which is applied for a forecasted earthquake to provide the magnitude, location, and time of the earthquake. *Munandar et al.* conduct data analytics concerning climate change using Principal Component Analysis

compounded with a Vector Autoregressive Integrated (PC-VARI) model, using several locations in Indonesia as cases.

Two ITDRR papers discuss *social media analytics*. *Rokuse and Uchida* address the challenges of using social media in disasters due to the high volume of data. Machine learning can help classify and extract useful information from tweets, but building models in real time is difficult. Therefore, a model trained on tweets from past disasters was used to extract location mentions from tweets posted during heavy rain disasters in Japan in 2018, 2020, and 2021. Combining data from multiple disasters achieved the best performance, and the model may have achieved generalization performance. Further studies will examine how the model performs with different types of disasters.

Bono et al. raise a popular topic on the use of social media as a source of real-time information that can support crisis response during emergencies. The authors propose a machine-learning-based system that detects the onset of emergency events through the analysis of word mentions on social media which is language-agnostic and can be applied to any language.

Lastly, the ITDRR 2022 authors have contributed from different perspectives in the *community resilience* section. *Matsuno and Matsuura* demonstrate how the use of gamification and serious games using a simulation application can provide knowledge and experience to the users on living in an evacuation shelter. *Gil et al.* propose a strategic approach for food system resiliency from a community-based initiative during the Covid-19 pandemic, using a case study in Medellin, Colombia. The study also identifies change factors considered as a long-term capability to enhance food resilience and to overcome food insecurity. Finally, *Nguyen et al.* provide a comprehensive design of an inventory to gather and manage resilience-related information. Overall, a lot of interesting contributions were provided by ITDRR authors.

The volume editors would like to express their special gratitude to the members of the Program Committee, and to the many reviewers of the papers, for their dedication in helping produce this volume.

ITDRR 2022 selected the following papers for the Best Paper Award and the Best Student Paper Award, based on the review results:

- *The ITDRR 2022 Best Paper Award*: Yasuhiro Soshino, Application of the Fuel Cell Vehicle to Support ICT in Emergency Response
- *The ITDRR 2022 Best Student Paper Award*: Stella Polikarpus, Edna Milena Sarmiento-Márquez, and Tibias Ley, Creation and Use of Virtual Simulations for Measuring Situational Awareness of Incident Commanders

We hope that these awards encourage the awardees and future candidates in their research work and submissions to our future conferences.

March 2023

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Terje Gjørseter
Yuko Murayama

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Jaziar Radianti	University of Agder, Norway
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Hans Jochen Scholl	University of Washington, USA
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