



HAL
open science

Information Technology in Disaster Risk Reduction

Yuko Murayama, Dimiter Velev, Plamena Zlateva, Jose J. Gonzalez

► **To cite this version:**

Yuko Murayama, Dimiter Velev, Plamena Zlateva, Jose J. Gonzalez. Information Technology in Disaster Risk Reduction. Springer International Publishing, AICT-501, 2017, IFIP Advances in Information and Communication Technology, 978-3-319-68485-7. 10.1007/978-3-319-68486-4 . hal-03213112

HAL Id: hal-03213112

<https://inria.hal.science/hal-03213112v1>

Submitted on 3 Jul 2023

HAL is a multi-disciplinary open access archive for the deposit and dissemination of scientific research documents, whether they are published or not. The documents may come from teaching and research institutions in France or abroad, or from public or private research centers.

L'archive ouverte pluridisciplinaire **HAL**, est destinée au dépôt et à la diffusion de documents scientifiques de niveau recherche, publiés ou non, émanant des établissements d'enseignement et de recherche français ou étrangers, des laboratoires publics ou privés.



Distributed under a Creative Commons Attribution 4.0 International License

Editor-in-Chief

Kai Rannenber, Goethe University Frankfurt, Germany

Editorial Board

TC 1 – Foundations of Computer Science

Jacques Sakarovitch, Télécom ParisTech, France

TC 2 – Software: Theory and Practice

Michael Goedicke, University of Duisburg-Essen, Germany

TC 3 – Education

Arthur Tatnall, Victoria University, Melbourne, Australia

TC 5 – Information Technology Applications

Erich J. Neuhold, University of Vienna, Austria

TC 6 – Communication Systems

Aiko Pras, University of Twente, Enschede, The Netherlands

TC 7 – System Modeling and Optimization

Fredi Tröltzsch, TU Berlin, Germany

TC 8 – Information Systems

Jan Pries-Heje, Roskilde University, Denmark

TC 9 – ICT and Society

Diane Whitehouse, The Castlegate Consultancy, Malton, UK

TC 10 – Computer Systems Technology

Ricardo Reis, Federal University of Rio Grande do Sul, Porto Alegre, Brazil

TC 11 – Security and Privacy Protection in Information Processing Systems

Steven Furnell, Plymouth University, UK

TC 12 – Artificial Intelligence

Ulrich Furbach, University of Koblenz-Landau, Germany

TC 13 – Human-Computer Interaction

Marco Winckler, University Paul Sabatier, Toulouse, France

TC 14 – Entertainment Computing

Matthias Rauterberg, Eindhoven University of Technology, The Netherlands

IFIP – The International Federation for Information Processing

IFIP was founded in 1960 under the auspices of UNESCO, following the first World Computer Congress held in Paris the previous year. A federation for societies working in information processing, IFIP's aim is two-fold: to support information processing in the countries of its members and to encourage technology transfer to developing nations. As its mission statement clearly states:

IFIP is the global non-profit federation of societies of ICT professionals that aims at achieving a worldwide professional and socially responsible development and application of information and communication technologies.

IFIP is a non-profit-making organization, run almost solely by 2500 volunteers. It operates through a number of technical committees and working groups, which organize events and publications. IFIP's events range from large international open conferences to working conferences and local seminars.

The flagship event is the IFIP World Computer Congress, at which both invited and contributed papers are presented. Contributed papers are rigorously refereed and the rejection rate is high.

As with the Congress, participation in the open conferences is open to all and papers may be invited or submitted. Again, submitted papers are stringently refereed.

The working conferences are structured differently. They are usually run by a working group and attendance is generally smaller and occasionally by invitation only. Their purpose is to create an atmosphere conducive to innovation and development. Refereeing is also rigorous and papers are subjected to extensive group discussion.

Publications arising from IFIP events vary. The papers presented at the IFIP World Computer Congress and at open conferences are published as conference proceedings, while the results of the working conferences are often published as collections of selected and edited papers.

IFIP distinguishes three types of institutional membership: Country Representative Members, Members at Large, and Associate Members. The type of organization that can apply for membership is a wide variety and includes national or international societies of individual computer scientists/ICT professionals, associations or federations of such societies, government institutions/government related organizations, national or international research institutes or consortia, universities, academies of sciences, companies, national or international associations or federations of companies.

More information about this series at <http://www.springer.com/series/6102>

Yuko Murayama · Dimiter Velez
Plamena Zlateva · Jose J. Gonzalez (Eds.)

Information Technology in Disaster Risk Reduction

First IFIP TC 5 DCITDRR International Conference, ITDRR 2016
Sofia, Bulgaria, November 16–18, 2016
Revised Selected Papers

Editors

Yuko Murayama
Tsuda University
Tokyo
Japan

Dimiter Velev
University of National and World Economy
Sofia
Bulgaria

Plamena Zlateva
Bulgarian Academy of Sciences
Sofia
Bulgaria

Jose J. Gonzalez
University of Agder
Grimstad
Norway

ISSN 1868-4238

ISSN 1868-422X (electronic)

IFIP Advances in Information and Communication Technology

ISBN 978-3-319-68485-7

ISBN 978-3-319-68486-4 (eBook)

<https://doi.org/10.1007/978-3-319-68486-4>

Library of Congress Control Number: 2017959617

© IFIP International Federation for Information Processing 2017

This work is subject to copyright. All rights are reserved by the Publisher, whether the whole or part of the material is concerned, specifically the rights of translation, reprinting, reuse of illustrations, recitation, broadcasting, reproduction on microfilms or in any other physical way, and transmission or information storage and retrieval, electronic adaptation, computer software, or by similar or dissimilar methodology now known or hereafter developed.

The use of general descriptive names, registered names, trademarks, service marks, etc. in this publication does not imply, even in the absence of a specific statement, that such names are exempt from the relevant protective laws and regulations and therefore free for general use.

The publisher, the authors and the editors are safe to assume that the advice and information in this book are believed to be true and accurate at the date of publication. Neither the publisher nor the authors or the editors give a warranty, express or implied, with respect to the material contained herein or for any errors or omissions that may have been made. The publisher remains neutral with regard to jurisdictional claims in published maps and institutional affiliations.

Printed on acid-free paper

This Springer imprint is published by Springer Nature

The registered company is Springer International Publishing AG

The registered company address is: Gewerbestrasse 11, 6330 Cham, Switzerland

Preface

The effects of disasters are very serious and it may take a very long time to recover from the destruction caused. The ensuing damage can be severe and offering relief may lead to expenses in the range of billions of euros. The occurrence of natural disasters has increased in the past few years and it is expected that their frequency will continue in the coming years.

Owing to the multidisciplinary nature of work in the field of disaster risk reduction, people from various backgrounds are included in this field of research and activity. Their backgrounds are likely to include industry, diverse geographical and global settings, not-for-profit organizations, agriculture, marine life, welfare, risk management, safety engineering, and social networking services.

At present, at global and national levels, a wide range of scientific and applied research activity is conducted in the area of disaster risk reduction concerning individual types of disasters. Modern information and communication technologies (ICT) can facilitate significantly the decision-making processes from the point of view of disaster risk reduction.

Following the increasing number of disasters worldwide and the growing potential of both ICT and ICT expertise, at its General Assembly held during October 8–9, 2015 at the Daejeon Convention Center, Daejeon, Korea, the IFIP established the Domain Committee on Information Technology in Disaster Risk Reduction in order to:

- Promote disaster risk reduction within the ICT community
- Provide an additional opportunity for IFIP members to work with other specialized bodies such as the UN, UNISDR, ICSU, ITU, and ISCRAM
- Coordinate the efforts of member societies as well as different Technical Committees and Working Groups of IFIP in the disaster-related field

The disaster support offered by the Domain Committee is based on the following major pillars:

- Information acquisition and provision
- Shelter information management for local governments
- Disaster information systems
- State-of-the-art ICT (such as the Internet of Things, mobile computing, big data, and cloud computing).

IFIP's Domain Committee on Information Technology in Disaster Risk Reduction organized the First IFIP Conference on Information Technology in Disaster Risk Reduction (ITDRR 2016), during November 16–18, 2016, at the University of National and World Economy, Sofia, Bulgaria.

ITDRR 2016 provided an international forum for researchers and practitioners to present their latest R&D findings and innovations. The conference was especially focused on various ICT aspects and the challenges of coping with disaster risk

reduction. The main topics included areas such as big data, cloud computing, the Internet of Things and natural disasters, mobile computing, emergency management, disaster information processing, disaster risk assessment and management, and disaster management simulation.

ITDRR 2016 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 dialogue and exchange of ideas among different levels of academic, research, business, and public communities.

The Program Committee received 52 paper submissions, out of which 20 research papers were finally accepted. We are particularly grateful therefore to the members of the Program Committee, and the many reviewers of papers, for their dedication in helping to produce this volume.

August 2017

Yuko Murayama
Dimiter Velez
Plamena Zlateva
Jose J. Gonzalez

Gabriela Marín-Raventós	IFIP Councillor, Costa Rica
Gansen Zhao	South China Normal University, China
Gerald Quirchmayr	University of Vienna, Austria
Hans J. Scholl	University of Washington, USA
Henrik Eriksson	Linköping University, Sweden
Hsin-Hung Wu	National Changhua University of Education, Taiwan
Jaziar Radianti	University of Agder, Norway
Jian Cao	Shanghai Jiaotong University, China
Jose J. Gonzalez	University of Agder, Norway
Josune Hernantes	University of Navarra, Spain
Julie Dugdale	University of Grenoble, France
Kai Ranenberg	IFIP Vice President, Germany
Kaninda Musumbu	Université Bordeaux, France
Kenny Meesters	University of Tilburg, Germany
Kim Hee Dong	Hankuk University of Foreign Studies, Korea
Leire Labaka	University of Navarra, Spain
Mariki Eloff	University of South Africa, South Africa
Mariyana Nikolova	NIGGG, BAS, Bulgaria
Michinori Hatayama	Disaster Prevention Research Institute, Kyoto University, Japan
Mihoko Sakurai	University of Agder, Norway
Monika Buscher	Lancaster University, UK
Murali Krishna Penmetsa	Gokaraju Rangaraju Institute of Engineering and Technology, India
Murray Turoff	New Jersey Institute of Technology, USA
Norberto Patrignani	Politecnico di Torino, Italy
Naoto Matsumoto	Sakura Internet Research Center, Japan
Nariyoshi Yamai	Tokyo University of Agriculture and Technology, Japan
Nirit Bernstein	Institute of Soil, Water and Environmental Science, Israel
Patrick Letouze	Universidade Federal do Tocantins, Brazil
Rajan Raj Pant	Information Technology Security Emergency Response Team, Nepal
Saji Baby	GEO International Environmental Consultation Co., Kuwait
Sergei Kavun	University of Banking of the National Bank of Ukraine, Ukraine
Sergei Ohrimenco	Laboratory of Information Security, AESM, Moldova
Shi Yizhe	Shenyang University of Chemical Technology, China
Shunsuke Fujieda	University of Tokyo, Japan
Starr Roxanne Hiltz	New Jersey Institute of Technology, USA
Stewart James Kowalski	Norwegian University of Science and Technology, Norway
Tadeusz Czachorski	Institute of Theoretical and Applied Informatics, PAS, Poland

Tao Bo	Earthquake Administration of Beijing Municipality, China
Tetsuo Noda	Shimane University, Japan
Tim A. Majchrzak	University of Agder, Norway
Tina Comes	University of Agder, Norway
Vassil Roussinov	Crisis Management and Disaster Response Centre of Excellence, Bulgaria
Victor Amadeo Bañuls Silvera	Universidad Pablo de Olavide, Spain
Victor de Pous	IFIP Legal Counselor, Netherlands
Wei-Sen Li	National Science and Technology Center for Disaster Reduction, Taiwan
Wolfgang Reinhardt	Universität der Bundeswehr, Germany
Youwei Sun	Earthquake Administration of Beijing Municipality, China
Yoshitaka Shibata	Iwate Prefectural University, Japan
Yutaka Kikuchi	Kochi University of Technology, Japan
Zong Xuejun	Shenyang University of Chemical Technology, China

Contents

Understanding the Importance of Proper Incentives for Critical Infrastructures Management – How System Dynamics Can Help.	1
<i>Denis Trček and Jose J. Gonzalez</i>	
A Proposal on Patient Transport Decision Making in Multiple Hospitals in a Large-Scale Disaster	9
<i>Jun Sasaki</i>	
Urban Disaster Simulation Incorporating Human Psychological Models in Evacuation Behaviors	20
<i>Tatsuya Yamazaki, Hiroyuki Tamai, Yasunori Owada, Kiyohiko Hattori, Shin'ichi Taira, and Kiyoshi Hamaguchi</i>	
Stalking Resilience: Cities as Vertebrae in Society's Resilience Backbone . . .	31
<i>Jose J. Gonzalez, Magnus Bång, Colin Eden, Raquel Gimenez, Josune Hernantes, Susan Howick, Patricia Maraña, Igor Pyrko, Jaziar Radianti, Amy Rankin, and Jose Mari Sarriegi</i>	
Usability Evaluation of Information Technology in Disaster and Emergency Management	46
<i>Tilo Mentler, Henrik Berndt, Daniel Wessel, and Michael Herczeg</i>	
Formal Methods for Safe Design of Autonomous Systems Dedicated to Risk Management	61
<i>Sophie Coudert and Tullio Joseph Tanzi</i>	
Using the Scorecard Approach to Measure Seismic Social Resilience in Nablus, Palestine.	77
<i>Vania Cerchiello, Paola Ceresa, and Ricardo Monteiro</i>	
Better Access to Terminology for Crisis Communications	93
<i>Mikael Snaprud, Jaziar Radianti, and Dag Svindseth</i>	
Towards European Dimensions of City Resilience.	104
<i>Jaziar Radianti</i>	
Climate Deterrence: Disasters and Security After COP 21	119
<i>Raul Kleber de Souza Boeno and Viriato Soromenho-Marques</i>	

Urban Planning with the Combined Method of Perception-Driven Joint Learning Approach (PeDJoLA) and Geographic Information Systems (GIS) Model for Disaster Mitigation	139
<i>Rahmat Widia Sembiring, Benny Benyamin Nasution, M. Syahrudin, Afritha Amelia, Bakti Viyata Sundawa, Zulkifli Lubis, Prayudi Nastia, Suhaili Alifuddin, Junaidi, Handri Sunjaya, Ismael, and Gunawan</i>	
The Planning of Smart City to Mitigate the Impacts of Natural Disaster in North Sumatera	147
<i>Dedy Hartama, Herman Mawengkang, Muhammad Zarlis, Rahmat Widia Sembiring, Benny Benyamin Nasution, M. Syahrudin, Prayudi Nastia, Abidin Lutfhi Sembiring, Saifullah, Eka Irawan, and Sumarno</i>	
Forecasting Natural Disasters of Tornados Using mHGN	155
<i>Benny Benyamin Nasution, Rahmat Widia Sembiring, Bakti Viyata Sundawa, Gunawan, Afritha Amelia, Ismael, Handri Sunjaya, Suhaili Alifuddin, Morlan Pardede, Junaidi, Muhammad Syahrudin, and Zulkifli Lubis</i>	
Enhancing Regional Digital Preparedness on Natural Hazards to Safeguard Business Resilience in the Asia-Pacific	170
<i>Yanling Lee, Kenji Watanabe, and Wei-Sen Li</i>	
A Comprehensive Decision Support System for Enhanced Emergency Decision Management and Training	183
<i>Odd Steen, Andrew Pope, Marion Rauner, Nicklas Holmberg, Simon Woodworth, Sheila O’Riordan, Helmut Niessner, and Karen Neville</i>	
The Generation of a Situation Model, in Real-Time, as a Support to Crisis Management	198
<i>Audrey Fertier, Anne-Marie Barthe-Delanoë, Aurélie Montarnal, Sébastien Truptil, and Frédéric Bénaben</i>	
Improving the Involvement of Digital Volunteers in Disaster Management . . .	214
<i>Roberto dos Santos Rocha, Adam Widera, Roelof P. van den Berg, João Porto de Albuquerque, and Bernd Helingrath</i>	
Disaster Reduction Potential of IMPRESS Platform Tools	225
<i>Nina Dobrinkova, Antonis Kostaridis, Andrej Olunczek, Marcel Heckel, Danae Vergeti, Sofia Tsekeridou, Geert Seynaeve, Andrea De Gaetano, Thomas Finnie, Efsthathiou Nectarios, and Chrysostomos Psaroudakis</i>	
M&S Support for Crisis and Disaster Management Processes and Climate Change Implications	240
<i>Orlin Nikolov, Nikolay Tomov, and Irena Nikolova</i>	

Assessment of Flood Vulnerability Using Fuzzy Logic
and Geographical Information Systems 254
Valentina Nikolova and Plamena Zlateva

Author Index 267