



# 8<sup>th</sup> ICBR INTERNATIONAL CONFERENCE ON **BUILDING RESILIENCE**

Risk and Resilience in Practice: Vulnerabilities,  
Displaced People, Local Communities and Heritages

## PROCEEDINGS

Editors:

A. Nuno Martins, Liliane Hobeica, Adib Hobeica, Mittul Vahanvati,  
Pedro Pinto Santos, José Manuel Mendes, Ali Jamshed



ORGANISED BY



UNIVERSIDADE DE COIMBRA



# 8<sup>th</sup> International Conference on Building Resilience

*Risk and Resilience in Practice: Vulnerabilities, Displaced People,  
Local Communities and Heritages*

14-16 November 2018 | Lisbon, Portugal

## 8<sup>th</sup> ICBR Lisbon Proceedings

*Edited by*

A. Nuno Martins, Liliane Hobeica, Adib Hobeica, Mittul Vahanvati,  
Pedro Pinto Santos, José Manuel Mendes, Ali Jamshed

November 2018

8<sup>th</sup> International Conference on Building Resilience, ICBR Lisbon'2018  
*Risk and Resilience in Practice: Vulnerabilities, Displaced People, Local Communities and Heritages*

8<sup>th</sup> ICBR Lisbon Proceedings | Book of Abstracts

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## Foreword

Development agendas adopted throughout 2015 and 2016, in particular the Sendai Framework for Disaster Risk Reduction 2015-2030 (SFDRR), the 2030 Sustainable Development Goals (SDGs), the New Urban Agenda and the Paris Agreement represent not only a unique landmark to achieve a shift of our societies and systems towards sustainability, but perhaps the last opportunity to preserve our planet. As more people and assets are located in areas of high risk, the proportion of world population living in flood-prone river basins have increased by 114%, while those living on cyclone-exposed coastlines have grown by 192% over the past 30 years. Over half of the world's large cities, with populations ranging from 2 to 15 million, are currently located in areas highly vulnerable to seismic activity. Rapid urbanization will further increase exposure to disaster risk. The World Economic Forum (WEF) has estimated that by the year 2050, the exposure of city dwellers to various hazards, including earthquakes, tsunamis, urban floods, cyclones and storm surges will double (WEF, 2014).

Cities are complex in nature. They consist of a number of interdependent physical systems and human communities which are vulnerable to disasters in varying degrees. Cities are seen as engines of economic growth where the majority of economic activity takes place. In many cases, city centres are considered to be the preferred location for economic, providing a thriving labour market and good service facilities to support business organizations. Increased global exposure to natural hazards has largely been driven by population growth and the trend for an increased proportion of that population to live in cities rather than in rural areas. As cities grow larger and become economically more productive, they serve as magnets for rural-urban migration. As urbanization continues, more and more people settle in cities, leading to urban sprawl and also to increasing densification. Urbanization has the potential to make cities more prosperous and countries more developed, but many cities all over the world are grossly unprepared for the multi-dimensional challenges associated with urbanization. As a result, the world's population is increasingly concentrated in large cities with poor housing and a lack of basic protective infrastructure. There is thus a high risk of economic loss, damage to assets, and human casualties and injuries in disasters and extreme weather events, making cities particularly vulnerable.

Achieving the SDGs in coherence with the 2015 development agenda means strengthening collaboration and developing joint efforts within governments to the lowest possible level. This is to ensure not only that an integrated approach is delivered but also that 'policy coherence' is guaranteed. The Sendai Framework and the New Urban Agenda represent a significant step forward in safe guarding the economic prosperity and supporting cities in ably localising their efforts – from the setting of goals and targets, to determining the means of implementation and using indicators to measure and monitor progress. In order to achieve SDGs 11.5 and 11.b at the local level, the disaster risk reduction (DRR) dimension needs to be integrated in local development plans, policies and budget, with clear roles and responsibilities within the local government. Local governments should conduct periodical participatory assessments to identify the most potential and worst-case scenarios including means to reduce their impact. Building codes and land-zoning regulations need to be updated and better enforced to improve the resilience of housing stock and infrastructure investments.

Local disaster risk governance must be strengthened through coalitions of local actors including public and private partners. Communities and related agencies and in particular urban planners need to be more involved in risk assessments and identification of vulnerabilities. Various tiers of governments need to set up coherent mechanisms that include financial and tax incentives that allow for engagement of private sector to invest in risk reduction. There is not a fixed blueprint. Each city has distinctive topography, population density, and vulnerabilities. Each city needs to assess its particular challenges. The good news is that it is possible for cities to overcome these crises.

*Abhilash Panda*

Deputy Chief of the UNISDR Regional Office for Europe and Central Asia

## Preface

As we approach the *8<sup>th</sup> International Conference on Building Resilience*, news broadcasters around the world are reporting the devastating impacts of disasters. From the 7.5-magnitude earthquake that triggered a tsunami and extensive soil liquefaction in Palu, Indonesia, to Hurricane Michael in coastal areas of Florida, USA, and Typhoon Mangkhutleft in Northern Philippines, the human and economic losses mount. The region hosting this year's conference is not immune either. A hot, dry summer has led to drought across much of Europe in 2018, followed in October by flash flooding in Central Europe.

The future looks even worse. The world's leading climate scientists have warned there is only a dozen years for global warming to be kept to a maximum of 1.5°C, beyond which even half a degree will significantly worsen the risks of drought, floods, extreme heat and poverty for hundreds of millions of people. In October, the authors of the report by the UN Intergovernmental Panel on Climate Change (IPCC) emphasised that urgent and unprecedented changes are needed to reach the target, which they say is affordable and feasible although it lies at the most ambitious end of the Paris agreement pledge to keep the increase in temperatures between 1.5°C and 2°C.

Policymakers commissioned the report at the Paris climate talks in 2016, but since then the gap between science and politics has widened, as some of the world's biggest source of historical emissions have started to back away from the accord. Despite such political challenges, the role of science is clear. The global plan for disaster reduction, the Sendai Framework, launched in 2015, duly recognises the importance of science and technology and calls for the enhancing of scientific and technical work on risk reduction and the coordination of existing networks and scientific research institutions at all levels and all regions. The plan, which replaced the Hyogo blueprint for disaster reduction, marked a fundamental shift in approach, with strong emphasis being placed on achieving evidence-based understanding of risk and its implications for disaster prevention, mitigation and response.

When we first started the International Conference on Building Resilience series in 2008, the theme was around physical reconstruction, in particular learning lessons from recovery after the 2004 Indian Ocean Tsunami, which had devastated parts of the host country, Sri Lanka. Since then, the conference has moved around the world, from the United Kingdom, to Australia, New Zealand and Thailand. In keeping with the Sendai Framework, the conference themes have also shifted to provide a platform for sharing international, multi-hazard, multi- and inter-disciplinary research that addresses the full spectrum of disaster prevention, mitigation and response. Since its inception and at the heart of the conference has also been the desire to strengthen the relationship between science, policy and action. The number of participants from non-academic stakeholders has significantly increased over the past decade.

Ten years after its inception, our team at the University of Huddersfield in the United Kingdom are delighted to support the University of Lisbon and the University of Coimbra in Portugal, which are organizing and hosting the 2018 International Conference on Building Resilience in association with the United Nations Office for Disaster Risk Reduction (UNISDR). This eighth conference in the series will take place in the historic city of Lisbon in Portugal. The theme for the conference reflects this historic setting, with a strong emphasis on heritage, but also the importance of people, their vulnerabilities, the impacts of displacement, and the importance of local communities in disaster risk reduction. We thank our hosts for taking on the responsibility for organizing this year's event. We are confident that it will continue the success of previous conferences and that its outcomes will support the implementation of the Sendai Framework for Disaster Risk Reduction 2015-2030.

Our best wishes to you all for fruitful discussions and a successful conference.

*Prof. Dilanthi Amaratunga and Prof. Richard Haigh*  
Global Disaster Resilience Centre, University of Huddersfield  
Chairs of the International Conference on Building Resilience series

## Welcome Note

Dear 8<sup>th</sup> ICBR participants,

On behalf of the Organizing Committee of the 8<sup>th</sup> ICBR 2018, which I proudly preside over an extraordinary team featuring experienced scholars and young researchers brought together in a balanced way, it is my great pleasure to welcome you all to Lisbon.

Following seven previous successful editions of this leading conference series on risk and resilience, held in different regions of the globe, this 8<sup>th</sup> edition is taking place for the first time in Portugal, being organized by the University of Lisbon, in collaboration with the Universities of Coimbra and Huddersfield, and held in the premises of the Lisbon University Institute (ISCTE-IUL), between 14 and 16 November 2018.

We feel honoured for having this opportunity of organizing a conference that becomes a reference on the annual calendar of those interested in disaster-related sciences. By bridging the gap between designers, disaster managers, and humanitarian and development practitioners, the ICBR has been promoting a vast interdisciplinary network aimed at strengthening and disseminating a culture of risk and resilience.

We have embraced the theme “Risk and Resilience in Practice: Vulnerabilities, Displaced People, Local Communities and Heritages” for the 8<sup>th</sup> ICBR with the goal of addressing some of the most challenging and pressing issues that concern academia, public administrations, the private sector, civil society and, last but not least, local populations, whom our individual and shared efforts are meant to impact in a positive way. In the light of the more than 600 quality submissions (papers and posters) that were received from more than 50 countries, this choice seems to have been particularly inspiring. Indeed, the upcoming Conference is putting together excellent pieces of research and amazing projects focusing on Disaster Risk Reduction, disaster preparedness, post-disaster rebuilding and recovery, and resilience in general.

The ICBR is already one of the landmark international forums on risk and resilience for cross-disciplinary ideas, policy guidance and social meeting. Both academics and practitioners will have the opportunity to question the most challenging and pressing resilience issues, exploring and learning about past, present and future collaborative paths.

As a novelty, this 8<sup>th</sup> ICBR edition introduces two special prizes: the *Building 4Humanity Design Competition* and the *Marielle Franco Community-Design Award*. As can be read further on in a dedicated section of this book, both prizes were successfully set up, with the help of committed partners and Jury members, and received valuable proposals from all continents. Furthermore, a mobile App was made available so that the delegates can easily access the information about the Conference, find out what is going on, consult the updates, see the Conference’s photos, view and download submitted posters, respond to the survey on the Conference’s sustainability features, and cast their votes for the selection of the best scientific posters and the best proposals submitted to the *Building 4Humanity Design Competition*.

Beyond the four special sessions focusing on the Conference’s motto, the 8<sup>th</sup> ICBR is enriched by six additional keynote speakers who join the set of prominent scholars participating in the event. The ICBR’s traditional PhD school will bring together several dozens of students from all around the globe and will benefit from the contribution of many of the 8<sup>th</sup> ICBR’s keynote speakers and Scientific Committee members. Finally, the Resilient Tours, to take place on Saturday 17 November, will invite the attendees to become a little bit more acquainted with our beautiful country, visiting World and National Heritage sites, outstanding landscapes, while getting to know disaster-prone areas and how the government, technicians and communities have coped with different types of hazards and recovered from disasters.

We would like to thank the keynote lecturers, the track chairs, with their substantial role since the drawing of the call for papers (promotion of authors' participation, review of submissions and moderation of sessions), the honourable members of the Scientific Committee, the sponsors, local partners, and all the delegates for sharing and presenting their research results.

We sincerely hope that you all enjoy the Conference, Lisbon and in a broad sense, your stay in Portugal.

With warm regards,

*A. Nuno Martins,*  
*8<sup>th</sup> ICBR Lisbon 2018 Chair*

The *8<sup>th</sup> ICBR Lisbon 2018 Organizing Committee*  
Chairs: *Nuno, José, Pedro, Isabel, Liliane and Adib*  
Organizing team: *Silvia, Rosa, Carla, Sarah, Mittul, Nuha, Ali, Mayeda, Oshien, Omimah and Franciele*  
Digital designer: *Dominika Gorecka*



## Conference Organization

### Conference Chairs

A. Nuno Martins (Chair) | CIAUD (Research Centre for Architecture, Urbanism and Design), Faculty of Architecture, University of Lisbon, Portugal

José Manuel Mendes (Chair) | CES (Centre for Social Studies), University of Coimbra, Portugal

Pedro Pinto Santos (Co-Chair) | IGOT (Institute of Geography and Spatial Planning), University of Lisbon, Portugal

Isabel Raposo (Co-Chair) | CIAUD (Research Centre for Architecture, Urbanism and Design), Faculty of Architecture, University of Lisbon, Portugal

Liliane Hobeica (Co-Chair) | University of Coimbra, Portugal

Adib Hobeica (Co-Chair) | Independent consultant, Portugal

### Advisory Committee

Dilanthi Amaratunga | Global Disaster Resilience Centre, University of Huddersfield, UK

Richard Haigh | Global Disaster Resilience Centre, University of Huddersfield, UK

### Honorary Committee

H.E. the President of the Portuguese Republic, Prof. Dr. Marcelo Rebelo da Sousa

H.E. the Secretary-General of the United Nations, Eng. António Guterres

The President of the Lisbon Municipality, Dr. Fernando Medina Maciel Almeida Correia

The President of the Coordination and Development Commission of the Centre Region (CCDRC), Prof. Dr. Ana Abrunhosa

The President of the Research Centre for Architecture, Urbanism and Design (CIAUD) of the University of Lisbon, Prof. Dr. Fernando Moreira da Silva

## Members of the Organizing Committee

### Local Team

Sílvia Martins | University of Beira Interior, Portugal

Astghik Grigoryan | University of Lisbon, Portugal

Rosa Arma | University of Lisbon, Portugal

Maria Carla Lostrangio | International Joint Master in Sustainable Territorial Development

Franciele Caroline Guerra | UNESP-Rio Claro, Brazil

### External Team

Mittul Vahanvati | RMIT University, Australia

Nuha Eltinay | London South Bank University, UK

Ali Jamshed | University of Stuttgart, Germany

Catherine Aguilar | University of the Philippines Los Baños, Philippines

Florence Zapico | Mindanao State University, Philippines

Mayeda Rashid | Central Queensland University, Australia

Omimah Alsaadi | Istanbul Technical University, Turkey

Oshienemen Albert | University of Huddersfield, UK

Sarah Tantely | University of Antananarivo, Madagascar

## Keynote Speakers

Dilanthi Amaratunga | University of Huddersfield, UK

Camillo Boano | University College London, UK

Christian Werthmann | University of Hannover, Germany

Isabel Raposo | University of Lisbon, Portugal

Ortwin Renn | Sustainable Institute Potsdam, Germany

Hsieh Ying-Chun | Atelier-3, Taiwan

## Keynote Speakers | Special Sessions

### *Special Session on Architectural Heritage*

Paulo B. Lourenço | University of Minho, Portugal

### *Special Session on Gender and Resilience*

Maureen Fordham | University College London, UK

### *Special Session on Wildfire Risk*

Fantina Tedim | University of Oporto, Portugal

Alan March | University of Melbourne, Australia

### *Special Session on Humanitarian Architecture and Incremental Housing*

Carmen Mendoza Arroyo | Universitat Internacional de Catalunya, Spain

Chen-Yu Chiu | Bilkent University, Turkey

## Members of the Scientific Committee

A. Nuno Martins | University of Lisbon and University of Beira Interior, Portugal  
Alan March | University of Melbourne, Australia  
Alexandra Paio | ISCTE (University Institute of Lisbon), Portugal  
Alexandre Oliveira Tavares | University of Coimbra, Portugal  
Ali Asgari | University of York, Canada  
Alice Chang-Richards (née Yan Chang) | University of Auckland, New Zealand  
Andreia Amorim Pereira | University of Coimbra, Portugal  
Anna Scolobig | ETH Zurich, Switzerland  
Aparna Tandon | ICCROM, Italy  
Astrid Skjerven | Oslo Metropolitan University, Norway  
Brenda Vale | Victoria University of Wellington, New Zealand  
Carlos Alejandro Echeverri | Universidad EAFIT, Colombia  
Carmen Mendoza Arroyo | Universitat Internacional de Catalunya, Spain  
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Catherine Forbes | GML Heritage and ICOMOS, Australia  
Champika Liyanage | University of Central Lancashire, UK  
Charles Parrack | Oxford Brookes University, UK  
Claude Yacoub | École Spéciale d'Architecture, France  
Claudio Accioli | UN-Habitat  
Dave Hampton | RE:GROUND LLC Resiliency Strategies, USA  
David Alexander | University College London, UK  
David Leite Viana | University of Minho, Portugal  
David Savage | University of Newcastle, Australia  
Diane Davis | Harvard University, USA  
Dilanthi Amaratunga | University of Huddersfield, UK  
Domingos Xavier Viegas | University of Coimbra, Portugal  
Ehsan Noroozinejad | Kerman Graduate University of Advanced Technology, Iran  
Emmanuel Raju | University of Copenhagen, Denmark  
Ermínia Maricato | FAU USP, Brazil  
Esmeralda Paupério | University of Oporto, Portugal  
Esther Charlesworth | RMIT University, Australia  
Ezri Hayat | University of Huddersfield, UK  
Fantina Tedim | University of Oporto, Portugal  
Fariha Tariq | University of Management and Technology, Pakistan  
Faten Kikano | Université de Montréal, Canada  
Fernando Dinis | University of Beira Interior, Portugal  
Georgia Cardosi | Université de Montréal, Canada

Giovanni Allegratti | University of Coimbra, Portugal  
Giuseppe Forino | University of Newcastle, Australia  
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Gretchen Kalonji | Hong Kong Polytechnic University, China  
Helen Giggins | University of Newcastle, Australia  
Helena Freitas | University of Coimbra, Portugal  
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Isabel Raposo | University of Lisbon, Portugal  
Isabel Vaz Freitas | Portucalense University, Portugal  
Isabelle-Anne Bisson | TerraHumana Solutions, Canada  
James Coburn | Berkeley University, USA  
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Jo Rose | University of York, UK  
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Jonas Jörin | ETH Zurich, Switzerland  
Jorge León | Universidad Técnica Federico Santa María, Chile  
Jorge Nicolau | University of Lisbon, Portugal  
Jorge Rocha | University of Lisbon, Portugal  
José António Bandeirinha | University of Coimbra, Portugal  
José Luís Zêzere | University of Lisbon, Portugal  
José Manuel Mendes | University of Coimbra, Portugal  
Kaushal Keraminiyage | University of Salford, UK  
Ksenia Chmutina | Loughborough University, UK  
Lee Boshier | Loughborough University, UK  
Leonardo Nogueira de Moraes | University of Melbourne, Australia  
Liliane Hobeica | University of Coimbra, Portugal  
Luciana da Silva Andrade | Federal University of Rio de Janeiro, Brazil  
Luciano Lourenço | University of Coimbra, Portugal  
Lúcio Cunha | University of Coimbra, Portugal  
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Makarand Hastak | Purdue University, USA  
Małgorzata Hanzl | Lodz University of Technology, Poland  
Margarida Pedroso Lima | University of Coimbra, Portugal  
Maria de Lourdes Zuquim | University of São Paulo, Brazil  
Maria Manuela Mendes | University of Lisbon, Portugal  
Mariana Correia | Escola Superior Gallaecia, Portugal  
Maureen Fordham | University College London, UK  
Mauro Cossu | Université de Montréal, Canada

Md. Humayun Kabir | University of Dhaka, Bangladesh  
Meltem Vatan | Bahcesehir University, Turkey  
Miguel Santiago Fernandes | University of Beira Interior, Portugal  
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Paulo B. Lourenço | University of Minho, Portugal  
Pedro Pinto Santos | University of Lisbon, Portugal  
Peeranan Towashiraporn | Asian Disaster Preparedness Center  
Raquel Rolnik | University of São Paulo, Brazil  
Regan Potangaroa | University of Wellington, New Zealand  
Richard Haigh | University of Huddersfield, UK  
Rodrigo Firmino | Pontifical Catholic University of Paraná, Brazil  
Sandra Carrasco | University of Melbourne, Australia  
Shenuka de Sylva | Victoria University of Wellington, New Zealand  
Sílvia Jorge | University of Lisbon, Portugal  
Sílvia Viegas | University of Coimbra, Portugal  
Sofia Morgado | University of Lisbon, Portugal  
Susana Pereira | University of Lisbon, Portugal  
Suzanne Wilkinson | University of Auckland, New Zealand  
Temitope Egbelakin | Massey University, New Zealand  
Teresa Cunha | University of Coimbra, Portugal  
Thayaparan Gajendran | University of Newcastle, Australia  
Tiago Miguel Ferreira | University of Minho, Portugal  
Tomás B. Ramos | NOVA University, Portugal  
Virginia Murray | Imperial College and King's College, UK  
Xavier Romão | University of Oporto, Portugal  
Zeynep Gul Unal | Yıldız Technical University, Turkey

## Programme Overview

Tuesday 13 November 2018	Wednesday 14 November 2018	Thursday 15 November 2018	Friday 16 November 2018	Saturday 17 November 2018
	8: 45   <b>Opening Ceremony</b> 9: 15   <b>Keynote Lectures</b>	9: 00   <b>Keynote Lectures</b>	9:00   <b>Keynote Lectures</b>	4 suggested <b>Technical Tours:</b>  # 1: Areas recovering from wildfires near Coimbra  # 2: Areas prone to flooding in the Tagus River Valley  # 3: Remains of the 1755 earthquake in Lisbon  # 4: Areas affected by extreme weather conditions (heat and drought) - Alentejo  <i>Note: the tours include visits along the road, site entrances, lunch, coffee break and refreshments.</i>
	10:45   <i>Coffee break</i>	10:30   <i>Coffee break</i>	10:30   <i>Coffee break</i>	
	11:00   Special Session*: <b>Architectural Heritage</b>   <b>Track Sessions</b>   <b>Doctoral School (1)</b>	11:00   Special Session*: <b>Humanitarian Architecture and Incremental Housing</b>   <b>Track Sessions</b>	11:00   Special Session*: <b>Gender and Resilience</b>   <b>Track Sessions</b>	
	12:45   <i>Lunch</i>	12:45   <i>Lunch</i>	12:45   <i>Lunch</i>	
	14:00   <b>Track Sessions</b>   <b>Doctoral School (2)</b>   <b>Marielle Award Jury Meeting (1)</b>	14:00   Special Session*: <b>Wildfire Risk</b>   <b>Track Sessions</b>	14:00   <b>Track Sessions</b>   Workshop: <b>Disaster Risk Reduction is Child's Play</b>   <b>B4H-DC Jury Meeting (1)</b>	
	15:45   <i>Coffee break</i>	15:45   <i>Coffee break</i>	15:45   <i>Coffee break</i>	
17:30 – 19:30   Registration desk opens	16:00   <b>Track Sessions</b>   <b>Doctoral School (3)</b>   <b>Marielle Award Jury Meeting (2)</b>	16:00   <b>Track Sessions</b>	16:00   <b>Track Sessions</b>   <b>B4H-DC Jury Meeting (2)</b>	
	18:00   <i>Building 4Humanity Design Competition (B4H-DC) – Opening of the Shortlisted Proposals' Exhibition</i>	17:45   <b>Poster Session</b>	17:00   <b>Closing Ceremony</b>   Announcements of the different award results, and presentation on the 2019 <i>ICBR</i> edition by the next organizers	
	19:15   <b>Welcome Reception</b>	20:00   <b>Conference Dinner</b>	18:00   <b>Traditional Magusto</b> (roasted chestnuts and sweet wine)	

\* The Special Sessions feature keynote speakers and accept submissions of abstracts and papers in limited number; they are planned to have as outcomes Special Issues of top journals.

## Awards

The *International Journal of Disaster Resilience in the Built Environment* (published by Emerald) sponsored the following awards granted to the 8<sup>th</sup> ICBR participants:

The Best Paper Award – Disasters and Built Environment.

Winners: *Elizabeth English, Michelle Li and Rebecca Zarins*, with the paper entitled “The economic argument for amphibious retrofit construction”.

The Best Paper Written by a Postgraduate Researcher Award.

Winners: *Finn Laurien, Stefan Hochrainer-Stigler and Adriana Keating*, with the paper entitled “Community flood resilience across the globe: empirical analysis of measurement and dynamics”.

The 8<sup>th</sup> ICBR also featured a special recognition to the Best Poster.

The Best Poster Award.

Winners: *Jean You and Manuela Powidayko*, with the poster entitled “New York City’s Flood Resilience Zoning Outreach Process: from community awareness to community empowerment”.

The Best Poster prepared by a Postgraduate Researcher Award.

Winners: *Ali Jamshed and Irfan Ahmad Rana*, with the poster entitled “Assessing the role of post-disaster resettlement in building resilience: the case of the 2010 floods in Pakistan”.



## Publications

Besides this book of abstracts, the 8<sup>th</sup> ICBR also features an e-Book of Proceedings with some of the papers submitted for the conference. A selection of around 50 papers will take part of very special publications, published by Elsevier. Each one of the four books will focus on one of Sendai's four priorities for action: (1) Understanding disaster risk; (2) Strengthening disaster risk governance to manage disaster risk; (3) Investing in disaster reduction for resilience; and (4) Enhancing disaster preparedness for effective response, and to "Build Back Better" in recovery, rehabilitation and reconstruction.

Moreover, high-quality papers will be selected for publication in one of the journals associated to the 8<sup>th</sup> ICBR:

### *International Journal of Disaster Resilience in the Built Environment*

The IJDRBE is the only journal to promote research and scholarly activity that examines the role of building and construction to anticipate and respond to unexpected events that damage or destroy the built environment.

Editors: Prof. Dilanthi Amaratunga | Global Disaster Resilience Centre, University of Huddersfield, UK

Prof. Richard Haigh | Global Disaster Resilience Centre, University of Huddersfield, UK

### *International Journal of Architectural Heritage*

The IJAH provides a multidisciplinary scientific overview of existing resources and modern technologies useful for the study and repair of historical buildings and other structures.

Editors: Prof. Paulo B. Lourenço | Universidade do Minho, Portugal

Prof. Pere Roca | Universitat Politècnica de Catalunya, Spain

### *International Journal of Disaster Risk Reduction*

The IJDRR publishes fundamental and applied research, critical reviews, policy papers and case studies focusing on multidisciplinary research aiming to reduce the impact of natural and technological disasters. The IJDRR stimulates exchange of ideas and knowledge transfer on disaster research, mitigation, adaptation, prevention and risk reduction at all geographical scales: local, national and international.

Editor in chief: Prof. David Alexander | University College London, UK

### *urbe. Revista Brasileira de Gestão Urbana*

To reach the complexity of urban phenomenon and its territorial materiality, urbe publishes theoretical and empirical papers involving discussions from the diverse issues that compose urban studies, such as urban and regional planning, architecture and urbanism, public management, public administration, public policies, geography, urban infrastructure, urban technology and environment.

Editor in chief: Prof. Rodrigo José Firmino | Pontifícia Universidade Católica do Paraná (PUCPR), Brazil

## Doctoral School

In keeping with the tradition of the Building Resilience conference series, the executive and scientific committees are delighted to present the Doctoral School as a special feature of the 8<sup>th</sup> ICBR in Lisbon. This is organized to celebrate the contribution of our doctoral students to the research community. Within this dedicated forum, doctoral students get an invaluable chance to discuss their research work with the wider researcher community and receive constructive feedback.

Some of the activities that will take place within the Doctoral School include:

- A series of lectures by experienced scholars: Prof. Nuno Martins, Prof. Kaushal Keraminiyage, Prof. José Manuel Mendes and Prof. José Luís Zêzere;
- A series of case studies presented by industry practitioners: Travis Bunt (One Architecture, USA), and Dave Hampton and Anya Brickman (RE:GROUND LLC Resiliency Strategies, USA);
- Interactive *PechaKucha* sessions in which doctoral students present their work to a panel of experts.

## The *Building 4Humanity Design Competition*

Following the trail of the 7<sup>th</sup> ICBR, which promoted the *Student Media Arts Competition*, the 8<sup>th</sup> ICBR and the Portuguese NGO Building 4Humanity have jointly organized as a side event the *Building 4Humanity Design Competition (B4H-DC)*. The Competition is aligned with the general aim of the *Sendai Framework for Disaster Risk Reduction* to achieve in 2030 “the substantial reduction of disaster risk and losses in lives, livelihoods and health and in the economic, physical, social, cultural and environmental assets of persons, businesses, communities and countries” (UNISDR, 2015). Targeted at both professional and student interdisciplinary teams, the *B4H-DC* has an open programme, covering design for resilience in any stage of the disaster risk management cycle: that is, focusing on either mitigation (“building better from the start”) or recovery (“building back better”). Each team was expected to present its own design programme, identifying a disaster-prone area (any hazard type) and proposing alternatives on how resilient buildings and settlements could support the building of communities’ resilience. The Competition comprised three different categories:

Category 1: Professional teams / built projects;

Category 2: Professional teams / unbuilt projects; and

Category 3: Student teams / unbuilt projects.

The *B4H-DC* successfully received in its first edition 60 architectural design proposals, tackling hazards such as floods, volcanoes, earthquakes and hurricanes, and also including slum-upgrading and refugee-related interventions. The participating teams and team members originated from all five continents, while the architecture schools from the following two universities were particularly active: Dar Al Uloom University (Saudi Arabia), with six student teams who focused on extreme weather conditions, and Universidad Rafael Landívar (Guatemala), with five student teams who delved into volcano-eruption risks.



**Location of the participating teams and focus of their architectural design proposals**

The submitted proposals were in a first stage evaluated and shortlisted by an international jury composed of more than 50 academics and practitioners, and presided by Carmen Mendoza Arroyo (Universitat Internacional de Catalunya, Spain), Christian Werthmann (Leibniz Universität Hannover, Germany), and Carlos Alejandro Echeverri (Universidad EAFIT, Colombia).

The evaluation of the proposals was guided by the following criteria:

- A) The quality of design, with particular emphasis on: (1) the robustness of the preliminary risk assessment as described in each team’s *Design Programme*; and (2) the ensuing resilience strategies and solutions proposed, and the answers to the programme;
- B) The quality of the overall framing and bonding of the design solution within the site/settlement, considering the utilization of local human and material resources, as well as the cultural, symbolic and spiritual endowments;
- C) The evidence and adequacy of design strategies for community engagement and residents’ involvement in the building, rebuilding or resettlement processes;

D) The value of the construction features, namely feasibility, cost-effectiveness, sustainability and, in particular, adaptability: to what extent the building/settlement can be delivered in a timely manner (the timeframe of the construction process), is extendable (scalable, expandable), flexible (versatile and convertible), recyclable (reusable).

In accordance with the final meeting of the second-stage evaluation Jury, held on 16 November 2018 during the 8<sup>th</sup> ICBR in Lisbon, the winners of the first edition of the *Building 4Humanity Design Competition* are:

**Category 1** (Professional teams / built projects):

– 1<sup>st</sup> prize: B4H-DC1152 (focus: resilience hub, France)

Members of the design team: *Constantin Petcou, Doina Petrescu and Anne Querrien*.

– 2<sup>nd</sup> prize: B4H-DC1108 (focus: floods, Peru)

Members of the design team: *Belen Desmaison, Kleber Espinoza, Urphy Vásquez and Fernando Carpio*.

– 3<sup>rd</sup> prize: B4H-DC1158 (focus: floods, Vietnam)

Members of the design team: *Elizabeth English, Pham Duy Tien, Nguyen Van Truoc, Teresa Tran and Thanh Tran*.

**Category 2** (Professional teams / unbuilt projects):

– 1<sup>st</sup> prize: B4H-DC2137 (focus: hurricanes, USA)

Members of the design team: *Anita Berrizbeitia, Angel Rodriguez-Colon, Eduardo Llinás-Meseguer and Judith Rodriguez Portieles*.

– 2<sup>nd</sup> prize: B4H-DC2102 (focus: wildfires, Australia)

Members of the design team: *Liz Brogden, Alexandra Illuk, Markos Hughes, Clare Kennedy and Nicholas McCarthy*.

– 3<sup>rd</sup> prize: B4H-DC2107 (focus: earthquakes, Japan)

Members of the design team: *Tadashi Saito, Hidenori Izumi, Yoshiro Namba, Kouji Mabuchi and Masakazu Terai*.

**Category 3** (Student teams / unbuilt projects):

– 1<sup>st</sup> prize: B4H-DC3104 (focus: slum upgrading, Brazil) – students from the Federal University of Rio de Janeiro (UFRJ, Brazil)

Members of the design team: *Pérola Barbosa, Ana Dresler, Raquel Penna, Patrícia Monteiro Santoro dos Santos and Pablo Benetti* (supervisor).

– 2<sup>nd</sup> prize: B4H-DC3117 (focus: volcanos, Guatemala) – students from Rafael Landívar University (Guatemala)

Members of the design team: *Lily Reina Chen Rosales, Valerio SenLin Lee Pacheco, María Alejandra Lima Morales, Jorge Mario Pérez Sosa, Gerardo Andres Rodas Valladares and Eduardo Antonio Andrade Abularach* (supervisor).

– 3<sup>rd</sup> prize: B4H-DC3142 (focus: floods and cyclones, Bangladesh) – students from the School of Planning and Architecture, Bhopal (India)

Members of the design team: *Vishal Kumar, Akhilesh Shisodia, Mohit Arya, Reva Saksena and Sanjeev Singh* (supervisor).

*A. Nuno Martins*, Director (Chair of the 8<sup>th</sup> ICBR)

*Liliane Hobeica and Adib Hobeica*, Executive Managers (Co-Chairs of the 8<sup>th</sup> ICBR)

The first edition of the *Building 4Humanity Design Competition* was sponsored by:



The first edition of the *Building 4Humanity Design Competition* was supported by the following associate partners:



## The Marielle Franco Community-Design Award



In association with the Portuguese NGO Building 4Humanity, the 8<sup>th</sup> ICBR has organized a very special prize, in parallel to the *Building 4Humanity Design Competition: the Marielle Franco Community-Design Award*. This award pays a tribute to Marielle Franco, sociologist and social activist cruelly murdered in Rio de Janeiro (Brazil) in March 2018, who was working towards the legitimization of architecture as a public service in her home city. The *Marielle Award* intends to recognize the activities of architects in interdisciplinary teams working within deprived areas, such as slums and other informal settlements threatened or affected by disasters, extreme poverty, armed conflicts, forced displacements, eviction or urban violence. Therefore, the purpose of the award is to acknowledge architects' creativity but also their intellectual integrity and moral strength in seeking to improve the lives of underprivileged families, emphasizing both the results and the participatory process behind physical interventions that have contributed to the improvement of the living conditions locally, the reduction of risks and the strengthening of resilience.

The aim of the *Marielle Award* is not to recognize projects in isolation but the overall work of architects who have been having concrete impacts in the lives of underserved communities. It intends to give visibility to the outstanding performance of architects playing an intermediary role in dweller-based processes of building new homes, incremental housing, and community indoor- and outdoor-space improvements. The main focuses of the *Marielle Award* are indeed the professionals and their work processes, more than the interventions per se, which are only used as proxies of their achievements. With a monetary value of 10,000 euros, the award is meant to be an incentive for the continuity of successful interventions, their scaling up or their replication elsewhere. The *Marielle Award* is supported by the Rio de Janeiro chapter of the Brazilian Council of Architects and Urbanists (Conselho de Arquitetos e Urbanistas do Brasil – CAU-RJ) and the Portuguese Order of Architects (Ordem dos Arquitectos Portugueses – OA), among others.

In its first edition, the *Marielle Award* received 17 outstanding nominations from all around the world, of architecture practitioners, groups of professionals and organizations with a long-standing experience and substantial achievements in co-working with families and neighbourhood associations. The nominees' works have truly impressed the eminent members of the Jury, presided by Prof. Anna Tibaijuka (former Executive Director of UN-Habitat) and Mr. Abhilash Panda (Deputy Chief of the UNISDR Regional Office for Europe and Central Asia).



**Location of the nominees and of the interventions showcased to represent their work**

Indeed, the materials produced and submitted by the nominators vividly highlighted the engagement and commitment of the candidates, the high quality of the spaces designed and built in a shared manner, as well as the impacts that architecture can have not only in the physical materiality of deprived contexts, but also as a promoter of empowerment processes. Another key aspect of the first edition of the *Marielle Award* was the fact that the great majority of the nominees are women or women-led groups and organizations, which was also reflected in the results of the first selection stage. The seven shortlisted candidates were (in alphabetical order):

- Afroza Ahmed (Bangladesh);
- Arquitetas Sem Fronteiras – ASF Brasil (Brazil);
- Carin Smuts (South Africa);
- Comunal: Taller de Arquitectura (Mexico);
- Mariana Estevão de Souza (Brazil);
- Office of Displaced Designers (Greece); and
- TAO-Pilipinas (Philippines).

In accordance with the final meeting of the second-stage evaluation Jury, held on 14 November 2018 during the 8<sup>th</sup> ICBR in Lisbon, the recipient of the first edition of the *Marielle Award* is the NGO Arquitetas Sem Fronteiras – ASF Brasil, represented by the project “Arquitetura na Periferia” (Architecture in the Periphery), located in Belo Horizonte (Minas Gerais, Brazil).

The NGO ASF Brasil was founded in 2003, inspired by Architects without Borders International, with the mission to identify, create and articulate socio-environmental processes and projects in territories occupied by marginalized populations, in order to contribute to the empowerment of local populations and the social production of fairer and more balanced cities. The processes and projects being developed seek to value resources and local potentials, favouring cooperation between different governmental levels and activating processes of negotiation between public and private initiatives. The carried out activities involve technical counselling in the fields of design and planning, legal advising, construction and urban environmental recovery, through social processes that favour collective autonomy and self-government capacity. A number of strategic plans, project proposals and works have been developed in such fields as the improvement of the quality of life and work of homeless people, the recovery of environmentally degraded areas, or the rehabilitation of African-American religious traditional houses (*terreiros de candomblé*).

The main objective of the Architecture in the Periphery social project (AnP) is to improve housing conditions for families living precariously in high-vulnerability areas through the encouragement of women’s autonomy and emancipation. Instead of simply offering a product – the design plans –, ASF Brasil shares knowledge, through a process of technical assistance targeted at women, using a methodology through which they learn basic practices and techniques of project design, planning, budgeting and construction, and also receive an interest-free micro-credit so that they can carry out their constructions autonomously and with no wastage. This entire learning and planning process ends up promoting not only the improvement of the houses, but also an increase in self-esteem and self-confidence of the involved women, as they realize that they are capable of doing things they never imagined before. The methodology used by ASF Brasil was originally developed during the Master in Architecture and Urbanism (2013/2014) of AnP’s current coordinator. The interventions already implemented through the AnP project have benefited 135 family members and range from the construction of previously inexistent bathrooms to the improvement of circulation, ventilation or natural lighting, to the installation of finishes and flooring that enhance house comfort. The AnP project has been providing a basis for women to strengthen their community bonds, to develop their critical and combative capacity in relation to current injustices, and to become the voices that will inspire other women living in similar contexts.

The first edition of the *Marielle Award* was supported by:



## Resilient Tours

The main idea of the Resilient Tours is to offer participants guided technical visits to one of four Portuguese sites that are particularly relevant from the risk and resilience points of view:

- Resilient Tour # 1: Areas recovering from wildfires near Coimbra (in the municipalities of Castanheira de Pera and Figueiró dos Vinhos).
- Resilient Tour # 2: Areas prone to flooding in the Tagus River Valley (in the municipalities of Vila Franca de Xira, Salvaterra de Magos and Santarém).
- Resilient Tour # 3: Remains of the 1755 earthquake and archaeological sites of Lisbon Downtown area.
- Resilient Tour # 4: Areas affected by extreme weather conditions (heat and drought), in the Alentejo region (municipalities of Évora and Mourão, namely the Alqueva Dam and the resettlement village of Aldeia da Luz).

The four Tours have a similar structure, comprising a cultural component in the morning, lunch, a scientific component in the afternoon, followed by a traditional *Magusto*. The one-day field trip will also be an informal occasion for further interactions between the 8<sup>th</sup> ICBR delegates.



*Keynote Lectures*

## “Earthquakes don’t kill, poorly constructed buildings do”

Dilanthi Amaratunga <sup>a,\*</sup>

<sup>a</sup> University of Huddersfield, UK

This keynote is an account of a study to identify gaps in the knowledge base of construction professionals that are undermining their ability to contribute to the development of a more disaster resilient society and preventing the mainstreaming of disaster resilience within the construction process, including: Governance, legal frameworks and compliance; Sustainability and resilience; Business continuity management; Ethics and human rights; Disaster response; Innovative financing mechanisms; Contracts and procurement; Resilience technologies, engineering and infrastructure; Multi-stakeholder approach, inclusion and empowerment; Knowledge management; Social and cultural awareness; Post disaster project management; and Multi-hazard risk assessment. These were identified from a detailed study to capture labour market requirements for disaster resilience, and its interface with the construction industry and its professionals. It further identifies a series of recommendations to key actors in the built environment on how to more effectively mainstream disaster resilience in the construction process. Integrating disaster risk reduction into development decisions is one of the most cost-effective way to reduce these risks. The higher education sector will need to play a significant role in addressing these knowledge gaps This includes the design and delivery of educational programmes, and the development and dissemination of new knowledge.

“If it is not risk informed, it is not sustainable, and if it is not sustainable, it has a human cost”

*Mami Mizutori*, The UN Secretary-General’s Special Representative for Disaster Risk Reduction  
and head of UNISDR

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## Being critical around resilience: bring about a future different from the present

Camillo Boano <sup>a,\*</sup>

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The paper aims to contribute to the debate about resilience offering some reflection from critical theory. It deliberately poses the question: there is a space for critical theory in resilience studies and disaster risk? Stemming from the complex encounters between environmental justice, and resilience and disaster studies, it aims to position some key critical thoughts emerging from a multiplicity of latitudes into the debate. Adopting some reflections on the pluriverse of Arturo Escobar, on active equality from Jaques Ranciere, on violence from Byung-Chui and infrastructural space from Keller Easterling the paper takes urbanity and urbanism as the central contested territory where uncertainty and vulnerabilities intersect on the material surface of the city. Such constellation of ideas might bring the fore to some provocative thoughts on the recognition of vitalism as form of resistance to the pervasive neoliberal systems that produce inequality, seclusion and risk accumulation and shed lights on we inhabit uncertainty, together'. The paper concludes with engaging with the world of social architecture and broadly spatial practices in suggesting an ethics of engagement, a materialist practice embracing and urbanism of inhabiting.

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# Anticipate! Field notes in the Human Age: the case of Canaan, Haiti and Medellín, Colombia

Christian Werthmann <sup>a,\*</sup>

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Theoreticians of the Human Age (Anthropocene) claim that the scale of human activity has been so massive that it has left a traceable imprint on the geology of the planet — a phenomenon often termed “the Great Acceleration.” Critics have pointed out that the narrative surrounding the Anthropocene fails to account for social issues such as rising global inequalities — a situation known as “the Big Divide.” This is problematic since the negative consequences of human activity, such as the effects of climate change, are mostly felt by low-income populations. There is a special urgency to address the environmental crisis of the Great Acceleration and the equality crisis of the Big Divide in tandem. For example: since safe land in urban areas is scarce, migrants and refugees in low-income countries will continue building on disaster-prone sites and humankind will continue to see an increase in urban vulnerability. In a best-case scenario, future migrant and refugee streams could be better anticipated and safe sites could be set aside to co-develop processes of urbanization with affected communities. In the moment however, we are far away from this type of anticipatory culture. Two recent examples:

Case # 1: Canaan and the duty of disobedience: after the 2010 earthquake in Haiti, the international community and the government had been incapable of providing sizeable housing opportunities for homeless survivors, despite over one billion USD in pledges. To the chagrin of the authorities, one of the largest self-constructed cities in Haiti (Canaan) developed only months after the earthquake, forming the largest construction site in the country at the time. As the land was occupied illegally, urgently needed assistance was not provided during its initial formation. Today, Canaan is one of the larger cities of the country.

Case # 2: Medellín and its refugees: the global reticence to accommodate refugees can even be observed in a country like Colombia that is used to prolonged refugee streams. The progressive city of Medellín that is admired globally for its innovative redevelopment projects is no exception. Civil-war-refugees whose only option was to build their houses in landslide-prone areas still feel treated as second-class citizens and demand a planning process that considers their rights and needs to secure their dwellings.

The two cases show some critical tasks for humankind in the Anthropocene. Canaan shows the vital need to reform how land ownership is governed and how housing has to be fostered as an incremental process that actively involves its future residents. Medellín has shown that even in the most progressive contexts, the long-term accommodation of refugees can remain elusive. On the one hand the two cases clearly show the inadequacy of formal responses, on the other hand they project hope by displaying tremendous human ingenuity on the side of migrants. As we are entering an age where large-scale migration and vulnerabilities will increase, methods and practices have to be found to develop a culture of anticipation that actively incorporates the creativity of affected populations.

Keywords: informal urbanization; disaster risk reduction; urban planning; Anthropocene; urban poverty.

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## GESTUAL: research and local action in the urban margins. Resistance and resilience

Isabel Raposo <sup>a,\*</sup>

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GESTUAL, the Group of Socio-Territorial, Urban and Local Action Studies, was born informally in October 2007, aggregating a small group of senior and junior researchers, teachers, students and professionals around a collective research project. This project approached, in a multidisciplinary perspective, the reconversion of the so-called neighborhoods of illegal genesis in Portugal, specifically those of the Lisbon Metropolitan Area. The group aggregated the synergies of this project with other previous projects, and consolidated a line of research that associates the matrix of critical thinking of Henri Lefebvre, with the premises of an interventive, collaborative and emancipatory urbanism: an alternative urbanism to the dominant system, which favours the socio-territorial cohesion, local solidarities and identities, the upgrading of the existent space and that aims to build a more inclusive city. On this path, GESTUAL attracted new members with similar concerns, urban planners, architects, designers, social scientists, and has been the stage for other collective projects of research and action, as well as individual research projects.

The urban margins and the housing areas have become the ground and the privileged themes of research and action of the GESTUAL. The suburbs, the peripheries, the public housing and, mostly, the so-called informal, illegal and irregular territories, which we call semi-urbanized or self-produced, are the most studied topics by the group. The socio-spatial dynamics of the housing territories are object of particular attention, either at the scale of the city or at the scale of the neighborhood and the public space, in a world increasingly globalized at the level of the dominant economy and of the socio-spatial dynamics. Spatial transformations are read as consequent of societal structures and conditions, as well as of the actions of a multiplicity of actors, from public powers and private interests to civil society, including local organizations and residents. The identification of tendencies of spatial transformation, the models and the underlying urbanistic and housing paradigms, the motivations, rationalities and practices that configure them, have, as their ultimate objective, to promote a reflection about how to do and what to do.

GESTUAL is committed by three fundamental rights: the right to housing, the right to place and the right to the city, understood in the emancipatory and transforming sense that Henry Lefebvre attributed to the last one (1974), recently revisited by David Harvey (2012). We want to identify the trends that are emerging, but also the practices and the resistances, the policies and the paradigms of urban intervention that are employed in the production of a city with more quality of life for all and with more spatial justice, citing Edward Soja (2010), among others authors. In this critical and reflexive presentation of the research and local action being developed by GESTUAL, in which I will underline the thematic and topics being studied, the main objectives, the main projects, their results and their impact on society and academy, I will emphasize the great lines of the theoretical and methodological framework that guides our research and action. It is within this theoretical scope that I will inquire the conceptual bridges between resistance and resilience, the guiding notion of this conference.

Keywords: GESTUAL, urban margins, right to the city, resistance, resilience.

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## Inclusive resilience: a new approach to risk governance

Ortwin Renn <sup>a,\*</sup>

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The concept of resilience has been used in many disciplines for different notions of being able to respond adequately when the system is under severe stress. It has been widely applied in ecological research and denotes the resistance of natural ecosystems to cope with stressors. Resilience is focused on the ability and capacity of systems to resist shocks and to have the capability to deal and recover from threatening events. This idea of resistance and recovery can also be applied to social systems. The main emphasis here is on organizational learning and institutional preparedness to cope with stress and disaster. The governance framework suggested by the International Risk Governance Council depicts resilience as a normative goal for risk management systems to deal with highly uncertain events or processes (surprises). It is seen as a property of risk-absorbing systems to withstand stress (objective resilience) but also the confidence of risk management actors to be able to master crisis situations (subjective resilience).

In my keynote lecture I will explain the connection between inclusiveness of risk governance based on multiple stakeholder involvement, and the need to enhance resilience, understood here as the capability of a socio-technical system to cope with events that are uncertain and ambiguous. This approach has been inspired by Lorenz, who distinguishes adaptive, coping and participative aspects of resilience. For this purpose, the resilience concept by Lorenz can be applied to link risk governance strategies with the three major aspects of resilience: adaptive management capacity, coping capacity, and participative empowerment. The three risk characteristics – complexity, uncertainty and ambiguity – can be linked to these three aspects of resilience.

Whereas the analysis of simple and – to some degree – complex problems is better served by relying on the physical and technical risk-based management methods, uncertain and ambiguous problems demand the integration of social constructions and mental models of resilience, operationalized as confidence in one's coping capacity, for both understanding and managing these problems. I will use this classification to discern between three management styles which correspond to these three aspects of resilience. I have called them: risk-informed (corresponding to adaptive capability); precaution-based (corresponding to coping capability) and discourse-based (corresponding to participative capability).

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## My community-based post-disaster housing reconstruction: architect Hsieh Ying-Chun and Atelier-3

Hsieh Ying-Chun <sup>a,\*</sup>

<sup>a</sup> *Atelier-3, Taiwan*

Over 70% of the world's population make their homes in rural areas. Under prevailing conditions of rapid economic development, traditional lifestyle and values are falling by the wayside. Villagers are forced to adopt unfamiliar techniques and materials and become thereby impoverished for life: they have exchanged their savings for new houses of reinforced concrete, brick, and tiles—materials that are costly, vulnerable to earthquakes, unhealthy for the environment, and unrelated in any way to inhabitants' familiar cultures. Professional architects are out of their depth in this sphere, having never so much as tested these waters before. Moreover, the issue of sustainable development ultimately concerns tests of survival for humanity as a whole, challenging both generally understood operational models in contemporary architecture as well as contemporary notions of value, even aesthetics...

With these predicating thoughts, Hsieh and his team proclaim that modern architecture is not a narrow matter of technology; for it necessarily involves considerations of economic, sociocultural, and environmental issues. Through the use of local source materials, low-cost building strategies and appropriate technologies, as well as the design of Hsieh's new open structural systems, the team has considerably lowered costs and technological thresholds. Peasant farmers are able to participate in their own modern home-building projects that also adhere to green, energy-saving, low-carbon standards, and vouchsafe the rights of members of this disadvantaged group to live and to work with dignity. At the same time, effective housing design must have flexibility; and sustainable architecture must reflect the diversity of the diverse regions and cultures.

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*Keynote Speakers / Special Sessions*



## *Special Session on Architectural Heritage*

### **Building resilience and cultural heritage buildings: earthquakes, blast and others**

Paulo B. Lourenço <sup>a,\*</sup>, Tiago Miguel Ferreira <sup>a</sup>

<sup>a</sup> *University of Minho, Portugal*

A hazard map cannot be related to a disaster map and disasters are the consequence of inappropriately managed risk. Construction history is full of examples of lack of success. The importance of ancient constructions has been for long exclusively associated with the use of the building, meaning that successive changes were made to the building in order to fulfil its new function. Presently, modern societies understand built cultural heritage as a landmark of culture and diversity, which should last forever, being the task of the current generation to deliver the heritage in good shape for the generations to come. This act of culture poses high demands to engineers because deterioration is intrinsic to life (as an example the expected life of a modern building is fifty years).

European countries have developed throughout the years a valuable experience and knowledge in the field of conservation and restoration. In recent years, large investments have been concentrated in this field, leading to impressive developments in the areas of inspection, non-destructive testing, monitoring and structural analysis of historical constructions. These developments and the recent guidelines for future reuse and conservation projects allow for safer, economical and more adequate remedial measures. The presentation will address aspects related to disasters, risk, earthquake and blast, discussing guidelines for future reuse and conservation projects, providing safer, economical and more adequate remedial measures, and concluding with some statements for discussion.

Over the period of 1992 to 2012, it is estimated that natural disasters, e.g. floods, storms, droughts, landslides, volcanic activities and earthquakes, have affected 4.4 billion people, causing 1.3 million deaths and leading to \$2 trillion in economic losses. Earthquakes have been responsible for 26% of the economic losses since 1900 but are the most significant natural disasters by death toll (6 in the top 10 world disasters in the last 40 years). 1. Since 1960, 40% of natural disaster deaths occurred as a result of earthquake events and 60% of these are due to masonry buildings, as more than half of the built heritage is unreinforced masonry. The evaluation of the seismic risk is considered essential to define strategic urban and emergency planning management actions, which should be based on the structural analysis of the buildings, the exposed population and their emergency interaction (i.e. evacuation). This kind of approach is urgently needed for complex scenarios, such as historical centers, which are often not properly investigated according to this holistic risk analysis standpoint. Some recent advances and applications at building and territorial level will be presented. Explosions threaten people's lives; threaten the integrity of buildings, industry, transportation, communications and services. The technical community is, in general, not prepared to deal with the design or evaluation of structures when subjected to these actions. Due to the global increase of explosions, either by terrorism or accidents, the need of research and development in this area is obvious. Some recent advances and applications will be presented.

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*Special Session on Gender and Resilience*

**‘It’s just what women do’: notions of vulnerability and resilience in  
post-conflict, post-disaster Nepal**

Maureen Fordham <sup>a,\*</sup>, Punam Yadav <sup>a</sup>

<sup>a</sup> *IRDR Centre for Gender and Disaster, University College London, UK*

This paper considers the opportunities lost or gained to address the needs and interests of recognised vulnerable groups in drafting the new 2017 Nepal Disaster Risk Reduction Act. Pregnant and newly delivered women and their newborns are top of the disaster vulnerability lists but this does not necessarily translate into action on the ground. This was shown starkly after the 2015 Nepal (Gorkha) earthquake where rural women spoke of the difficulties of reaching hospitals over damaged roads; giving birth on hospital floors strewn with glass; and living outside, with no food or extra clothing after the event. Some of the worst experiences were shared by those who were initially displaced during the ten years of civil war and then again by the 2015 earthquake. Women and their families were living in old houses because of the affordable rent. However, these were the houses which collapsed during the earthquake. While house owners subsequently received support to rebuild their houses, those who were renting and displaced could not afford the higher rents of the new houses. This paper draws upon two pieces of research in Nepal: the first was undertaken as part of the UK Research and Innovation (UKRI) Global Challenges Research Fund (GCRF)-funded MANTRA Project; the second comprises analysis of interviews carried out among earthquake-induced IDPs in Nepal.

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## *Special Session on Wildfire Risk*

### Enhancing wildfire resilience to extreme wildfire events

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Wildfires are an issue of global concern for their number, burned surfaces, suppression costs, and mainly because of the escalating direct and cascading effects when they appear under the form of extreme wildfire events (EWE). These events are rising in occurrence mainly due to land management practices, climate change, urban sprawl in hazardous areas, and paradoxically, to suppression policies. Almost every year, EWEs of unprecedented size and intensity appear on the global scenario and exceed all previous records. EWEs represent a huge threat to society as they present high intensity, behave and spread erratically and unpredictably, largely exceeding all efforts of control even in well-resourced regions until there is a break in fuels or relief in weather. EWEs are neither an ecological inevitability nor necessarily they lead to disasters, but the current policy of “war against fire” (i.e. aggressive fire suppression) based on reactive measures is inadequate to cope with this type of fire.

A wide body of scientific literature, and political strategies, have proposed “coexist with fire” as an alternative and distinctive paradigm, adopting a proactive and long-term approach of wildfire management entailing more resilient societies. Many times the term resilience has been used on wildfire field without a clear definition of its meanings. This is not a minor issue, for a term with a long historical etymology, used by different disciplines and political arenas with different meanings, and serving different purposes. Despite the absence of agreement on its definition, there is some consensus on broad parameters of resilience, namely the capacity to respond to, and recover from a wildfire to reduce its impacts.

Resilience perspective can be seen in terms of how well society deals with wildfire hazard, using a holistic approach integrating ecosystems, the built environment, the individuals, communities and society in an inter-relational and place-based perspective. A wildfire resilient society should act on different directions: i) on fire hazard by reducing the number of anthropogenic ignitions, decreasing fire intensity and the rate of spread; ii) on vulnerability, by lessening the propensity of exposed elements to suffer damage and loss when impacted by a wildfire; and iii) by enhancing the capacity of response and recovery (i.e. resilience).

The challenge is how to operationalize wildfire resilience in an efficient way. Several programs and frameworks have been proposed at community and landscape levels: FireSmart: community protection, Firewise Communities, Fire adapted communities, Risk-to-resilience continuum, Integrated fire management, Fire smart landscape management, and Community-based fire management. Another recently proposed concept is Fire Smart Territory (FST). Its scale of intervention is the territory which encompasses both the human and the ecological systems framed by power relationships and a system of governance, where the choices and capabilities of the actors, influence the conditions for wildfires to start and their impacts. FST is not a “one-size-fits-all” check list of procedures, but represents the opportunity both to understand the ecological, social and political processes that are responsible for wildfire risk creation and to support tailored solutions to building wildfire resilience.

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## *Special Session on Wildfire Risk*

# Lessons from an Australian wildfire disaster: integrating urban planning, building and emergency management

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The state of Victoria is located at the south corner of Australia's mainland. Small by Australian standards, it is approximately 22.8 million hectares and has a population of just under 6 million people. The majority of these people, some 4.5 million, live in the capital, Melbourne. The state of Victoria has relative autonomy as part of Australia's federated system to pass legislation and manage its own affairs.

Wildfire is Victoria's greatest natural hazard risk, followed by flood, heatwave, storm and earthquake, understood in terms of likelihood and consequence. Wildfire risks in Victoria are possibly the highest in the world and derive from the large areas of highly flammable eucalypt forest combined with large areas of highly flammable grasslands, a climate of relatively mild, and wet winters that are followed by hot, windy and very dry summer periods. In combination, there are long and regular drought that farm processes that utilise fire, population growth in wildfire-prone areas, such as the rural-urban fringe.

Wildfires mainly pose threats as a function of their interactions with human settlements. The main manifestation of wildfire disaster events occurs when extreme wildfires interact with urban areas adjacent or within vegetation, particularly dwellings, resulting in the ignition of multiple homes whereby fires cannot be contained by emergency response approaches. These extreme events are more likely to occur in rural and urban fringe areas because of the conditions and the extensive fuel sources in the environment. Hundreds or even thousands of buildings can be destroyed within hours in extreme cases.

While Victoria has a long history of wildfires, it was not until the 2009 Black Saturday fires that an extensive program of risk reduction across the state was introduced. This approach has drawn together fire response and emergency managers with urban planning, building, design, community education, forest management and social services. Central to this long-term program of risk reduction is the development of an integrated approach to urban planning and building regulation.

After describing the characteristics of the 2009 Victorian fires, this paper sets out a critical review of the main parameters of the approach taken in Victoria. Victoria now has a relatively well developed system in place to deal with wildfire threats. Since structures ignite in wildfires where sufficient fuel, heat and oxygen exist to maintain a fire, a range of mechanisms now seek to modify this. Similarly, approaches to dealing with aspects of radiation and convection heating impacts combined with direct flame contact, radiant heat and ember attacks are employed to reduce the likelihood of structural ignition. Mechanisms to reduce the impacts of ember attacks are also employed, particularly since winds can carry embers for long distances. Finally, the choice of building materials, design, and site location combine with garden design and wider vegetation management impacts of the performance of buildings during wildfires. The paper concludes with an appraisal of Victoria's progress in dealing with wildfire, combined with a range of challenges that remain.

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*Special Session on Humanitarian Architecture and  
Incremental Housing*

Centre for World Citizens, Reyhanlı, Hatay, Turkey

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Over 5.6 million people have fled Syria since 2011, seeking safety in Lebanon, Turkey, Jordan and beyond. Turkey alone has welcomed a staggering number of 3.6 million Syrian refugees over this period of time and this number excludes the many more unregistered people.

Reyhanlı, a small border town in the province of Hatay, located on the southeast of Turkey, is the main gate between the two countries. The town becomes the main entry point for the incoming surge of refugees as the civil war escalates. Over the span of time, a portion of refugees move to different countries – using Turkey as a bridge – some move more inward into Turkey settling in different cities, while the majority are still housed in camps and some choose to stay in Hatay, the main burden being on Reyhanlı. In 2010 Reyhanlı's population was 90,000. Since the start of the crisis, the total population has more than doubled. The town was not prepared for such a sudden increase in population and thus, started facing a socio-economic crisis. Currently, Reyhanlı has the highest refugee to local people ratio in Turkey.

Funded by the Ministry of Foreign Affairs, Taiwan, as a collaborative project between Turkish and Taiwanese governments, universities and NGOs, the Centre for World Citizens, Reyhanlı, Hatay, Turkey, was initiated in 2017. The talk will explain the rationale, intention and process of this project, as well as its prospects and challenges.

Keywords: informal urbanization; disaster risk reduction; urban planning; Anthropocene; urban poverty.

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## *Special Session on Humanitarian Architecture and Incremental Housing*

### Creating social and spatial integration frameworks: overcoming the emergency approach to urban refugee reception models

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With an unprecedented number of people displaced worldwide and particularly with the influx of refugees fleeing war, violence or natural disasters, the issue of preparedness of the host countries as well as the integration of newcomers into societies is becoming a core issue for all European cities. When it comes to displaced populations and refugees, as architects and urbanists we must ask ourselves if by upgrading and designing camps we are helping, or just maintaining the state of exception these camps are, and by doing so, contributing to governments and policies that want to keep them out of our cities.

As a self-proclaimed 'Refugee City', Barcelona as of 2015 is developing a special reception and integration plan, in order to offer support to refugees avoiding marginalization and ghetto effects. However, there still is a need of integrating refugees in a sustainable way, preventing the conflicts and the perception of them as an economic and social burden, and give a voice to all stakeholders in the refugee integration process. With this perspective, we present an initial research which intends to provide sustainable spatial and social refugee integration strategies, as a protocol. Our aim is to develop at the urban sphere, a shift in urban governance and planning from traditional urban planning, mostly related to the top-down and long term normative framing of land use, to raising awareness of a more adaptive and flexible approach about land use regulations in order to respond to immediate stresses (forced migration etc.). From a physical integration perspective, urban Refugees need to connect to the neighbourhood and create an identity within this new urban place, therefore we believe adaptive reuse of existing buildings allows to ensure connectivity to the existing social facilities and commercial activities, all which can similarly enhance cultural and economic integration. Finally, adaptation of refugees to host communities must incorporate analysis of the diverse cultures as well as a very important aspect which is gender, as there are changing roles of men and women among refugee populations. In this sense, the project will introduce a social integration protocol which can foster cultural change, as it will be a real process in collaboration with the local residents and the refugees through the incorporation of refugee housing in areas where local residents live.

Concretely, we expect to contribute to advances in the field by: (1) providing strategic information for decision-makers and local governments to maximize the cost-efficiency of public investment in urban refugee housing and, (2) improving citizen perception towards refugee integration, and enhance their empathic behaviour towards refugee communities. The humanitarian field benefits from a design practice that is seen as an expanding field rather than being developed in isolation (i.e. just for specialists). Engagement and situated practice is the key for the ethical approach to research and practice developed today.

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*Theme 1*

UNDERSTANDING DISASTER RISK

## TRACK 1A

Resilience of communities in long term displacements and  
Resilient communities at the centre of Big Data analytics

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Nuha Eltinay | London South Bank University, UK



## Big Data from social media to understand collective action

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Disasters can foster social cohesion among affected people. In this work, we use text data collected from Hurricane Sandy (2012, New York City) as a case study and show that it is possible to analyze how a grass-root disaster relief network emerged after a natural disaster, and subsequently how social media played a key factor. Social media, such as Facebook and Twitter, can aid in measuring the depth of social cohesion amongst users of #OccupySandy. We posit that social Media became essential to complement and enhance the relief efforts from the government and volunteers to cope with the aftermath of Hurricane Sandy. Furthermore, #OccupySandy users formed a socially cohesive – still active group – around their shared perception of an inadequate management from government officers. For the analysis, we use a mixed method approach, combining natural language processing and sentiment analysis with a qualitative review of Facebook and Twitter for #OccupySandy. Movements like Occupy Sandy can help detect potential collective actions, which in turn can be used by disaster response agencies to improve their actions. The analysis showed that social media allowed Occupy Sandy to start organizing immediately after Hurricane Sandy had made landfall. Moreover, Facebook and Twitter allowed the disaster-relief network to formulate calls for action and share information easily. Thereby, Occupy Sandy kept its posts and Tweets relatively brief and asked precisely for specific needs of supplies or workforce. Furthermore, the results of the analysis revealed that especially Facebook posts including photos reached a particularly high number of users who liked, shared, or commented on the post. Regarding the content of these posts, three main patterns could be observed: (1) Spreading positive news in the form of photos resulted in a particularly large amount of user reactions. (2) Occupy Sandy often blamed formal organizations for responding inadequately to the disaster. (3) In many highly outreaching posts, the disaster-relief network urged users to stand together as a community and help each other.

Keywords: social media; social cohesion; grass root movements.

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## Communicating risks: factors influencing Filipinos living in high-risk areas to follow preemptive evacuation procedures

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With recent mega disasters, risk communication has become one of the important areas in disaster risk reduction. Pre-emptive evacuation has been a practice in the Philippines to lessen the number of casualties. Risk perception as part of the risk communication process was explored using the three predictors of the Theory of Planned Behavior. The researcher surveyed 1,200 respondents from the provinces of Aurora, Eastern Samar, and Davao Oriental of the Philippines regarding factors that influenced the participants to follow pre-emptive evacuation orders. This study explored factors that include attitude towards being safe, secured and comfortable, and acceptability of being called an evacuee; societal factors that include local officials, friends, experts, television and radio; and perceived control that includes difficulty and confidence in following evacuation and influences from government, family, and faith. The researcher explored the significance of socio-demographic and economic variables such as age, sex, civil status, income, education, home ownership, living arrangement, awareness and knowledge on the proximity of the evacuation center. The researcher also investigated the effectiveness of National Disaster Risk Reduction and Management Council's (NDRRMC's) communication process in giving evacuation orders. Results were scored based on the recommendation of Francis and colleagues (2004), statistical models such as factor analysis, data reliability test, and Ordinary Least Squares (OLS) were used to examine the validity and relationships of factors. Overall, socio-demographic and economic determinants were significant in following pre-emptive evacuation procedures, with subjective Norms having the strongest positive impact on the desired behavior. The respondents experienced the highest social pressure to the local officials; however, level of importance of external referent differs across all the provinces. The aggregated results showed the strongest relationship of income, awareness of the evacuation center and knowledge on the proximity of the evacuation center to the three predictors of the Theory of Planned Behavior; however, findings show nuances on the significance of socio-demographic determinants unique to locations in the provinces. Results revealed that the existing programs of the government on disaster management are focused more on building awareness that helped in building the intention to follow pre-emptive evacuation procedures. Results emphasized the interaction between important players in risk communication process, specifically giving pre-emptive evacuation procedures, rather than specific control of one player over the other. The dependency of the Local Government Units to the National Government Agencies that affects the risk decision-making process stresses the importance of streamlining the communication flow of the NDRRMC. Aggregated results revealed that the three predictors were found to have a positive impact on the intention and showed a strong behavioral intention to follow pre-emptive evacuation procedures. Subjective Norms have the strongest positive impact on the desired behavior. This revealed that the respondents still experienced social pressure and motivation from external referents. Risk communication strategies should be designed context specific.

Keywords: preemptive; evacuation; risk communication.

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## Learning from Syria: applying environmental modeling toward strategic peacebuilding interventions

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As climate change intensifies droughts and other extreme weather processes, much of the world will face freshwater scarcity, causing major challenges for food production. Without international support, these disruptions will likely lead to increased violent conflict and political destabilization. However, targeted interventions using environmental peacebuilding have the potential to prevent political breakdown, lessen migration, and ultimately help poor regions to achieve sustainable development. This paper analyzes links between Syria's 2006-2010 drought crises and subsequent instability and conflict at the subnational level as a case study to better identify precise locations in which drought and socio-political impacts are most intimately connected. The study uses GIS mapping of high resolution satellite data in combination with cluster analysis, multiple linear regression, and causal mediation analysis to identify locations within Syria in which the occurrence of drought significantly predicted subsequent migration and protest. The analysis confirmed links between Syria's drought crisis, its subsequent internal migration and resulting socio-political instability, and its ongoing conflict. Drought led to internal migration: People appear to have fled agricultural areas impacted by drought, moving to cities and areas that were less hard-hit. Syria's 2011 protest locations correlated both with subdistricts that received significant influxes of people and subdistricts that were impacted by drought. This result suggests that drought increased the likelihood of protest both locally, through its direct impact on farmers, and in other locations, where its impact on protest was mediated by migration of people from one subdistrict to another. Because of the Syrian government's violent crackdown on protests, the occurrence of protest in a subdistrict significantly predicted the scale of the violence that followed, as measured by the number of civilian deaths directly caused by the ongoing conflict. Through this causal pathway, drought increased the likelihood of protest in a given subdistrict and thus the scale of the loss of life that followed. The greatest value to have come out of this analysis, however, is not the fact that climate impacts such as drought are linked to increased instability and conflict, or even the role that migration plays in linking drought to conflict. It is the ability to determine, at the subnational level, in what types of locations drought and socio-political instability are most closely linked. Mapping Syria's environmental and population factors revealed the existence of three different areas in which subdistricts could be grouped together according to shared characteristics. Out of the three subregions studied, only the first, an ecologically rich area supporting substantial rain fed agriculture and high population densities, showed strong direct links between drought, outbound migration, and local protest. It is in this type of location where environmental peacebuilding interventions would likely have achieved the greatest impact. The investigated links between climate, migration, and protest proved the strongest in lush regions supporting intensive rain fed agricultural production and high population densities, suggesting that proactive, targeted environmental interventions to support agricultural productivity and water conservation in similar regions could prevent political violence and accompanying human suffering at significantly lower cost than would post-conflict interventions.

Keywords: climate; migration; conflict; resilience; Big Data.

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## Assessing urban resilience to extreme weather events based on human mobility perturbation

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The frequent occurrence of extreme weather events such as rainstorms and consequent floods has posed serious threats to cities, often leading to traffic paralysis, facility damages and even fatalities and injuries. There is substantial need to enhance the resilience of cities to the impacts of extreme weather events, for which quantifying resilience is of fundamental importance, as it sets the benchmark for assessing the effectiveness of any resilience enhancement measure. A number of resilience assessment approaches and associated resilience indicators have been proposed in prior research. However, most of the existing approaches are either too theoretical or too complex to be implemented in practice, and are not developed specifically for measuring cities' abilities to deal with extreme weather events. Human mobility, which represents the characteristics of people's displacements in an urban space, is subject to perturbation when extreme weather events happen. Perturbed human mobility represents a reflection of the impacts that extreme events exert on cities and their populations. In this study, an approach is proposed for assessing urban resilience, by measuring the level of perturbation of human mobility caused by extreme weather events. Specifically, it is assumed that the average travel distance of urban population will decrease due to disrupted commuting conditions. Hence, a performance indicator is proposed, by calculating the ratio of average travel distance of urban population during an extreme weather event to its normal level. A larger performance indicator suggests less impact of the extreme weather event to urban human mobility and hence supposedly less impact to overall urban functionality. The value of the performance indicator varies as the extreme weather event evolves over time. Drawing on Bruneau's resilience assessment framework, an urban resilience indicator is then proposed, which can be calculated by integrating the value of performance indicator over the entire lifespan of an extreme weather event. The proposed urban resilience assessment approach and resilience indicator were validated in a case study based on a specific mode of transport. The trajectories of 7,100 taxis in the City of Nanjing, China collected between June 3<sup>rd</sup> and June 17<sup>th</sup>, 2017 were processed to assess the resilience of the city to a record-breaking rainstorm that happened on June 10<sup>th</sup>, 2017. Each trajectory was composed of a series of GPS locations, which were reported by GPS sensors attached to the taxis every 10 seconds. Daily and hourly travel distances of each taxi were calculated, and the performance indicator was calculated at these two granularity, respectively. Then, based on the proposed approach, the urban resilience indicator, as reflected by the taxi mobility, was calculated. The results showed that the proposed approach was able to capture the impacts of the rainstorm event on taxi mobility in Nanjing, and demonstrate the evolution of the impact over the lifespan of the rainstorm event. In addition, the results showed that the resilience indicator based on hourly travel distance noticeably outperformed the one based on daily travel distance, at marginal additional computational costs.

Keywords: urban resilience; indicator; rainstorm; human mobility; taxi trajectory.

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## The use of Big Data to monitor global data on disaster losses in the Arab Region

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Big Data ecosystems emerged as a revolutionary systematic approach to managing data across disciplines. Nonetheless, the lack of standardisation of disaster data losses, issues around balancing openness with privacy while capturing the dynamics of hazards, exposure and vulnerability in the context of climate change, remain a global challenge. With the aim of building Urban Resilience for Human Settlements, this paper explores the challenges of utilising Big Data to translate city resilience indicators from the reductionist numerical indexes to operational action plans. This is based on the rationale that such comprehensive resilience assessments are critical to effective national disaster risk reduction plans, where climate change adaptive principles can easily be mainstreamed into city planning and urban governance. A detailed analysis of the Sendai Framework for Disaster Risk Reduction (SFDRR) Monitor system (online tool) will be undertaken to assist in understanding national governments reporting mechanisms, by which climate change-induced risks are better understood and aimed to achieve the Sustainable Development Goals (SDGs). After the adoption of Sendai Framework in 2015, the 2018 system is now the official online tool to report to both the Sendai Framework and SDGs reporting processes. A theoretical framework of Data associated terminologies (Accessibility, Sharing, and usability) will be explored to enable critical appraisals of prescribed policy responses to Sendai 38 indicators in achieving its 7 Global targets. Recommendations from this paper will inform the debates around the United Nations 2015 Global Frameworks call on nation states to create innovative knowledge sharing national DRR platforms, to support the accessibility to all stakeholders in disaster risks management, and capture of trans-boundary nature of climate change effects to reduce mortality and economic losses from disasters, decreasing damage to critical infrastructure, and increasing the number of countries with national and local DRR strategies.

Keywords: Big Data; climate change; planning; open-data; risk.

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## The uses of vetiver grass: a remarkable resilient planning for the Rohingya refugee camps in Bangladesh

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Rohingya crisis is an international concern across the globe. It has been estimated that the 830,000 Rohingya refugees are taking place in the refugee camps as well as the majority of the refugees are women and children. The condition of the Rohingya refugee camps is highly congested which outbreaks, many diseases and makes difficult to provide services and facilities. The resilience of refugees in long-term displacement is needed to ensure a safer life for the refugees. Because the humanitarian aspect demands safety and dignity for every single human being. We can ensure a resilient life to the refugees by not only providing them their needs but by providing them with a sound healthy life. The big data analysis is needed for the Rohingya refugees to ensure what kinds of services will ensure a healthy and resilient life to them. By analysis the factors it would be a great help for the international humanitarian organizers, government, aid works to do cross-functional approach for giving sustainable life to the refugees in recent studies, it has been anticipated that the human settlement is at risk of flooding and landslides during monsoon. The flooding is co-related to the sea-level rising, which is also related to climate change impact. The landslide will occur because people are reshaping the slopes for making the house which also goes against the rules of nature. Nature will take its own revenge to get back to its previous position. The upcoming disasters will create a huge humanitarian crisis in the overcrowded camps like Kutupalong and Balukhali because 585,000 refugees are taking place in these camps. This will create inaccessible for trucks to supply relief, medicines, food and other necessary elements in the refugee camps. The cost-effective resilient plan is needed for the land use planning to reduce the impact of landslide and flood. To protect the slopes of the camps we can use vetiver grass because the strong and finely structured root systems are as strong as Iron. It can also perform against any climatic change, slope protection and stability. That is why it was called “Miracle Grass”. The vetiver grass will give both natural and social outcomes. The natural outcome will be enhancing the amount of grass will bring a greenish nature and the social outcome will ensure environmental protection as well as cherish the lives of refugees. The paper also aims how the use of vetiver grass can protect the vulnerability of refugees as well as create the greenery environmental impact in the Rohingya refugee camps. It will also figure out that the vetiver grass could be a low-cost and environmentally friendly alternative solution to create the sustainable resilient livelihood for the refugees in the camps. In the global world, not only the Rohingya camps but also other refugee camps across the globe should welcome diverse sustaining solutions to make the good life for the refugees in the long run. We may not make the value of risk and vulnerability zero, but we can apply diverse and alternate solutions to make the refugees as the part of the global map.

Keywords: Rohingya; refugee camps; vetiver grass; environmental and refugees.

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## DisplacementSim: simulating population displacement using agent-based simulation approach

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Population displacement is generated by a variety of natural, technological, and human made triggers. Disaster events such as flooding, hurricanes, wildfires, dam failures, industrial explosions, wars, and conflicts are examples of these sources. Level of displacement caused by these triggers is also impacted by individual, family, community and environmental characteristics and attributes. As such modelling population displacement has been very complicated theoretically and technically. Understanding temporal and spatial patterns of displaced population is very crucial for humanitarian and emergency management agencies that are providing support services to displaced population. Despite of advances in data collection, data analytics, and prediction models, humanitarian agencies are still looking for tools that can provide them with information that can better predict and estimate population displacement in time and space where they can expedite and optimize their logistical supports. Use of agent-based modelling (ABM) has shown promising results in population displacement in recent years. Availability of data, software and hardware platforms and tools, have created potentials for developing detailed modelling and simulation tools that can be used by various agencies that are dealing with various types of population displacement. This paper presents the methodology and applications of an Agent-Based Modelling and Simulation platform called DisplacementSim.

**Keywords:** agent-based modeling; population displacement; DisplacementSim; humanitarian logistics; temporary resettlement.

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## Displacement and rapid urbanisation: a literature evaluation of the challenges of the displaced people due to oil led environmental disaster in the Niger Delta Region

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The rate of the urbanisation of the developing countries in recent years is phenomenal and unprecedented, much more than it has been in the history of man. This rapid urbanisation has led to urbanity gradually taking over rurality in line with the argued urban age phenomenon. Surprisingly, some of these countries have kept urbanising rapidly amidst poverty. Edward Glaeser, a Harvard Economist, termed this kind of urbanisation as 'poor country urbanisation', urbanisation without industrialisation. It implies that the urbanisation of these countries is happening without the building of factories and industries, hence, the concentration of the urban population on consumption cities (where the economy consists of non-tradeable goods). This type of urbanisation suitably explains the rapid urbanisation occurring in the oil-rich Niger Delta region of Nigeria. Scholars in this region, see oil as one of the factors that contribute to the rapid urbanisation of the oil-rich region. Although there is no consensus among the scholars as to how oil contributes to the rapid urbanisation of the region. However, one of the outstanding argument is that oil contributes to urban population growth in the region through the streams of forced migration resulting from forced displacement of people due to oil led environmental disasters. Recently, statistics reveal that there are about 29 million people forcibly displaced who have continued to seek safety in cities, and they are often vulnerable. The level of these set of people in any community may as well mean the level of the vulnerable people in such communities, and this in one way or the other may have consequences on the development of such communities. It is arguable that for a country with a high rate of the displaced people to catch up industrially with the rest of the world, there should be sufficient policies meant to ensure that those who fall under these categories in both the cities and rural areas receive a long-term mode of livelihood and safety. While considerable studies have focused on the challenges of urbanisation in the region, there seems to be the neglect of the hardships that bedevils the forcibly displaced people in the oil communities whose force migration contributes to this rapid urbanisation. Accordingly, this study aims to identify the challenges of the displaced people due to oil led environmental disasters in the Niger Delta region and also evaluate the possible ways to alleviate their hardships. With the use of a comprehensive literature review, this study seeks to answer these questions: what are the challenges/difficulties faced by the forcibly displaced people in the oil-rich communities in the Niger Delta region? In what ways can these hardships be alleviated? The answers generated from these research questions will form the central part of the policy recommendation to the government in the region.

Keywords: displacement, urbanisation, oil, environmental disaster, Niger Delta region.

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## TRACK 1B

### Resilience, vulnerability, exposure and hazards: discussing and operationalizing concepts

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## Subjective perceptions of community resilience to natural hazards: the Norwegian story

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Attempts to measure resilience usually fall into two categories: (1) top-down indices based predominantly on official statistics and (2) bottom-up community self-assessments relying on the knowledge of experts and community leaders. This paper pursues an approach that is based on the idea that individuals, ordinary people, are often well placed to assess their communities' resilience to adverse events. In contrast to 'objective' top-down indices that, by necessity, reduce communities to large geographic areas and people to population count (as the basis for calculation of certain indicators), measuring perceived resilience provides community-specific assessments that are coloured by personal values and experience. This paper uses data from a survey designed to capture individual's perceptions of community resilience within the Norwegian context. The survey was implemented in January 2018 and completed by more than 1,800 respondents across Norway. Using correlation and regression analyses, the paper examines how individuals' perceptions of community resilience are influenced by personal factors, such as their respective household preparedness level, knowledge of the local environment, place attachment and previous hazard experience. Preliminary findings suggest that better knowledge of the local environment; greater place attachment and higher levels of household preparedness positively affect the individual's perception of the community's resilience capacities, whereas previous natural hazard experience has no impact on the perception. However, when considering only those respondents who have previously experienced natural hazard events, the perception is influenced negatively by increases in the severity of the experienced consequences. On a critical note, it should be stressed that it is difficult to test hypotheses if the attributes comprising the resilience construct are not conceptually independent from the factors contributing to it. Moreover, by focusing on resilience capacities rather than on resilience processes, the dynamics of lived community resilience cannot be captured. That is why it is proposed to test and further develop the resilience conceptualisation used in this paper with field studies of communities that have been affected by natural hazards.

Keywords: survey; quantitative analysis; preparedness; local knowledge.

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## A review of flood vulnerability indices for coastal cities

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Combinations of qualitative and quantitative measurements are increasingly used to identify vulnerability to disasters in urban areas around the world. In the context of increasing global urban population and changing climatic conditions, these indices provide policymakers and researchers with a means to measure vulnerability between urban areas and in specific locations over time. However, urban geographies and sub-geographies are subject to different kinds of disaster scenarios and experience vulnerability in different ways. As such, a number of indices spanning spatial scales and disaster categories have proliferated in recent years in attempt to provide an empirical basis with which to understand vulnerability. This paper focuses specifically on vulnerability indices designed to measure vulnerability to coastal flooding and provides a systematic review of literature related to the design and implementation of these indices in order to determine overarching conceptual groupings and their relevance. This review of existing methods will provide the foundation for a summary of the field of flood vulnerability index creation, including a comparative analysis of the applicability of indicators across categories. Flood vulnerability index methodologies are identified through keyword searches in Google Scholar and other academic databases. The majority of included literature combines indicators in terms of a number of sub-categories related to economics, social systems, environmental characteristics, the built environment, and institutional aptitude. This paper catalogues the component parts of 20 indices and presents the categories, indicators, and combinatorial methods used in each case. The results show that a great deal of variability exists across indices in terms of the area of interest scale (ranging from nation to city) and areal unit of analysis scale (ranging from county to census block group). Similarly, I find that the methods used to combine indicator values, as well as the weights attributed to each, vary across the literature, highlighting a degree of subjectivity related to context and data availability. While no consensus has been reached on a universally-accepted methodology for calculating flood vulnerability, I conclude by arguing that prevalent trends in the field highlight thematic areas of agreement and topics for further study.

Keywords: flood vulnerability; index creation; coastal cities.

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# A dilemma of language: ‘natural’ disasters in academic literature

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For over 40 years, scholars across various fields have been emphasising that disasters are ‘not natural’. The most common definition of a disaster is ‘A serious disruption of the functioning of a community or a society at any scale due to hazardous events interacting with conditions of exposure, vulnerability and capacity, leading to one or more of the following: human, material, economic and environmental losses and impacts’ (UNISDR, 2018, authors emphasis). This highlights that disasters occur due to the interaction of natural hazards with social and human vulnerability, including development activities that are ignorant of local hazardous conditions. Vulnerability originates in human experience and ‘represents the physical, economic, political and social susceptibility or predisposition of a community to damage in a case [of] a destabilising phenomenon’ (Cardona, 2003, p. 37), meaning that a series of extreme (yet often permanent) conditions make some social groups fragile. Thus, disasters do not impact all communities and societies equally: disasters impact disproportionately on the poor and marginalised. Nevertheless, many scientific disciplines refer to disasters as ‘natural’. For many researchers that focus mostly on the “natural hazard” component of a disaster, the construct may seem to be valid. But in many social science disciplines the term sits uncomfortably at best, particularly given the contemporary understanding of the role of vulnerability in driving disaster impacts in society. This paper argues that by putting the responsibility for failures of development on ‘nature’, we enable those who create disaster risks by accepting poor urban planning, increasing socio-economic inequalities, non-existent or poorly regulated policies, and lack of proactive adaptation and mitigation to avoid detection. We support the argument by analysing over 300 academic papers published since 1976 in six key journals in disaster studies. We find that research using the misnomer often focuses on impacts of hazards and risks and discusses vulnerabilities of those affected; this highlights that authors realise that whilst hazards are natural, disasters are not. Despite the widespread awareness in academic community of the problem, the use of the misnomer actually appears to be growing. As we increasingly see disasters framed in “narratives of destruction” that are hazard-centric and depoliticised, we must find ways to push back against the trend. A great concern is the use of the misnomer among scholars that are researching human vulnerability. The analysis shows three most prominent contexts within which the misnomer is used: 1) Trying to highlight the difference between natural and human-induced hazards (using the phrase as a way to indicate that the disaster has a “natural trigger”); 2) Using the term as a buzzword (without considering the implications); and 3) A hazard-focused approach to the problem (with authors falling into this language without thinking). All these uses are problematic as they disconnect the reality of the most vulnerable by continuously blaming “nature”. If science is really to support those in society most at risk, our language must be used to accurately apportion blame to the real root causes of disaster; i.e. the socio-economic rather than the natural.

Keywords: disaster; language; nature; communication; meaning.

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## The concept of resilience in Chile since the earthquake of February 27, 2010: state of the art and future challenges

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Before the earthquake occurred in Chile in February 2010 (27F), resilience to disasters in the academic field was based on a psychological and social approach, studying it mainly at the individual or family level. The 27F was a tipping point in relation to risk management in Chile and the involvement of State, civil society, academia and the private sector. This event and those that have happened since then (volcanic eruptions, earthquakes, floods, forest fires, landslides, and an extensive drought) have kept disasters in the fore. Based on a review of academic articles, government plans and policies, websites of civil society organisations and research centres, along with an open search of concepts such as “resilience Chile” and “disaster resilience Chile” on Google, Google Scholar and Twitter, the evolution of the term resilience (in the face of disasters) is analysed, along with its institutional and political implications. The National Policy of Disaster Risk Reduction (DRR) and its strategy consider resilience among the objectives for DRR, with no specific definition. In addition, the National Commission for Resilience against Disasters of Natural Origin produced in 2017 the “National Strategy for Research, Development and Innovation a Resilient Chile in the Face of Disasters of Natural Origin” without explaining what is meant by resilience. International institutions, civil society and some municipalities, on their part, have promoted initiatives aimed at improving resilience in cities, from different existing frameworks: the development focus of UNDP, the Making Cities Resilient campaign of UNISDR, and 100 Resilient Cities of the Rockefeller Foundation, among others. In these cases, each initiative employs its own definition of resilience being the widest in scope the one of Rockefeller Foundation. Furthermore, the emergence of several research centres and NGOs, as well as the strengthening of humanitarian aid organisations, and the proliferation of research initiatives from 2010 onwards, have put the term resilience and others on the public sphere, although not much has been done regarding discussing their definitions or implications along the disaster cycle; moreover, the permeability of research results to the general public is still something unusual. Resilience is supposed to be known for everyone and it has become “fancy”. The concept has expanded to many fields and spheres: “community resilience”, “resilient planning”, “urban resilience”, “resilient landscapes”, “resilient social housing”, “resilient coastline”, “resilient infrastructure”, “resilient economy”, and “Chile, a resilient country”, among others, are widely used. The media, the internet, and social networks have had a multiplying role, but not without risk in terms of the misuse and political bias with which the expression has been frequently used. Resilience is considered positive, understood as the capacity of people to face the difficulties posed by disasters and adapt to post-disaster circumstances, but not regarding transformation for reducing future risks and for being better prepared, for example. As little discussion is observed on the scope and consequences of the term resilience, adopting it rather as a premise, without questioning its implications from practice, is dangerous although poses numerous challenges for academics, politicians and decision makers.

Keywords: resilience; 2010 Chile earthquake; disaster management.

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## Analysing city-scale resilience using a novel systems approach

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In an increasingly complex world, the resilience concept helps deal with uncertainty and unexpected change. However, its polysemy has sparked debate in the literature leading to ambiguity in terms of conceptualising, measuring and applying the concept across different disciplines. For example, in the physical sciences, resilience is often conceptualised as preventing change with the aim of ‘bouncing back’ to normal conditions as quickly as possible after a disaster. In contrast, the social sciences often define resilience as enhancing coping capacity in various systems, concentrating on adaptive learning and transformative change. This paper aims to bridge this gap through understanding the complex interactions and interdependencies between critical infrastructure, flooding and human vulnerability which determine a city’s resilience. A systematic review on the concept of resilience was conducted in order to understand how resilience was being defined, measured and operationalized within the context of flood risk management (FRM). Findings suggest that resilience is a tripartite concept which includes the capacity to withstand, the capacity to absorb, and the capacity to adapt and transform. Taken together, these concepts conceptualize both the slower and faster scales of resilience, across multiple spatial scales. However, when it comes to ‘doing resilience’, all three capacities are rarely accounted for. This paper will incorporate the findings of the review into a systems approach to urban resilience. Instead of a purely physical approach to FRM, a systems approach explores the complex web of social and technical interactions and how they combine to affect critical system functionalities. In particular, an abstraction hierarchy of how the city functions will be modelled, with individual buildings/households at the bottom and the functional purpose of a city at the top of the hierarchy. Each scale is connected through means-ends links in order to capture functionality – with the functions being increasingly abstracted with each layer of the hierarchy. Along with the different spatial scales, it also incorporates the different temporal scales of resilience. For example, the immediate exposure to flooding can be analysed using graph theory metrics to see how the impact of a building being flooded propagates through the wider system, allowing identification of critical nodes. Moreover, it can also account for the slower variables of resilience by adjusting the node strength higher up the abstraction hierarchy in light of different policy or adaptation strategies. Again, this can be compared to the baseline during a flood event of a given magnitude. In essence, the abstraction hierarchy contributes to a better understanding of the complexity of the city and helps to determine the crucial points of failure when a city is subject to flooding, and what the failure of such a service would mean for different populations and their corresponding vulnerabilities. The first step in operationalising the resilience concept is presented in this paper using results for Natchez City, USA and Hulme, UK to explore the role of exposure and how a city absorbs the impact of a flood.

Keywords: resilience; exposure; flooding; systems approach.

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## Heritage conservation and tourism: uneasy alliances towards cultural resilience

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Resilience is becoming an increasingly important topic of academic study. Heritage conservation and heritage tourism share heritage sites as a common object of study, and the notion of resilience originally emerged in both areas as an ecological approach. More recent inroads into social resilience in these two areas (heritage conservation and heritage tourism) have yet to examine resilience from a cultural perspective, i.e., what we call here “cultural resilience”. The notion of cultural resilience for this conference presentation is limited to the context of physical built heritage. Cultural resilience is a complex notion. It requires consideration not simply of the built heritage (physical site), but also intangible dimensions, like the relationships between the site and its stakeholders (past and present), and what the site means to them. Stakeholders here include those directly related to the site’s heritage, local area residents, and vulnerable populations, historically oppressed or marginalized groups that may have a direct claim on the site for social well-being and cultural identification. Identity politics, power relations and economic issues arise here that also need to be addressed. How heritage conservationists use and operationalize this concept at built heritage sites is not only challenged by the social and political context in which the site is embedded, but also the tourism stakeholders whose interests lie primarily in site use and marketing for visitation. It requires identifying diverse values and interests, addressing the capacity of the heritage sites to withstand hazards, material degradation, plus use and visitation; conservation needs in light of use and visitation; its importance to local / area residents; area aesthetics; resource constraints, and the well-being of vulnerable populations and diverse groups who may have direct interests and affiliations with the site. In-depth review of the academic literature and the notion of resilience in heritage conservation and tourism studies, was performed in order to identify analytical parameters useful for addressing cultural resilience in heritage sites that are also visitor destinations. These parameters were applied to a case study of Alcatraz Island, USA, a National Parks Service managed protected site. Results indicate that an integrated approach between heritage conservation and tourism is needed in conserving, planning and managing the site. Close attention is needed to understand how each side perceives the interactions between tangible (e.g. buildings) and intangible (e.g. values and symbolism, relationships) aspects of the site. Identifying common ground and principles requires multi-stakeholder collaboration and must include those who stand to be most impacted by decisions made by heritage conservation and tourism experts. Power relations and participatory issues abound, particularly with respect to vulnerable populations and historically marginalized groups affiliated directly with the heritage site. A preliminary definition and some guiding principles for cultural resilience in the context of built heritage are proposed.

Keywords: heritage conservation; heritage tourism; cultural resilience; well-being.

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## A people-centred approach to programme design: exploring adaptation ideas to vulnerabilities in Darfur, Sudan

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The Vulnerability Risk Assessment (VRA) is a stakeholder led participatory assessment tool developed by Oxfam that helps to jointly identify root causes of vulnerabilities, priority hazards, existing capacities and the generation of transformative solutions to these vulnerabilities. The VRA has been used globally in diverse range of contexts and recently Oxfam has been exploring how it can contribute to linking humanitarian and development programming in protracted crisis like Darfur (Sudan). By building bottom-up co-owned adaptive solutions this assessment can provide a reframing of chronic issues and promote programming that moves away from intermediary service-delivery towards building resilience and supporting transformational change for the communities. It can also support improved collective actions and more accountability for duty bearers in places where lack of good governance, exclusion and inequalities are often root causes of continued vulnerability and poverty. The objective of this case study is to present the process and the outputs of the VRA that was carried out in North and South Darfur in November 2017 in partnership with two local partners: Kabkabya Smallholders Charitable Society and Jabal Marra Charity Organisation. The participants have been selected to form a Knowledge Group (KG) that worked together to complete five tasks to help build a shared picture of both natural and human-made risk exposure in their communities. The KG participants explored frequency and scale of impact to agree on a set of priority hazards and social issues. Subsequent discussions explored the impact of these hazards and it was a valuable opportunity for stakeholders to see the diversity of consequences and how these occur across different timeframes, scales and different groups. In this case, they bridged natural/climate change related risks and social issues linked to power, governance, government investment/budgeting and human-made shocks like conflict. The range of issues identified, and the varied ways people and livelihoods are affected showed the complexity of vulnerability in protracted crises and the need for analysis that goes beyond linear and restrictive thematic specialties and siloes. Risks affect people differently and there is a need to better understand how their risk profile is determined, escalated and/or perpetuated by both individual and contextual factors. As the VRA is committed to exploring bottom-up innovations around adaptive change, the focus was also on designing potential solutions that would enable communities and affected populations to have improved capacities to cope, thrive and achieve well-being. Using the Africa Climate Change Resilience Alliance 'Characteristics for Adaptive Change' a shortlist was developed into implementable strategies. For resilience programming to be successful and sustainable at scale it needs to invest in technological and governance solutions that address both the equipment and skills needed to adapt livelihoods and lifestyles to climate change but also tackles human behaviours linked to power, inequality and accountability. The VRA provided an opportunity to strengthen stakeholder relations and collaboration between government actors and community members which can assist the design and implementation of inclusive and more sustainable adaptive measures to build resilience of households, communities and the systems to their priority risks.

Keywords: vulnerability; conflict; power; transformation; complexity.

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## Index study: social vulnerability to drought in rural Malawi

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In Sub-Saharan Africa, meteorological drought is a frequent hazard. Climate change is predicted to increase drought frequencies, and alongside a growing population present unprecedented pressure on water resources. Drought as a disaster may manifest in many ways, a key factor determining drought impact is the vulnerability of the socio-economic receiving system and communities. Social Vulnerability Index (SVI) studies seek to quantify the intangible aspects of vulnerability using a numerical system of indicators to score the susceptibility to hazard. Previous studies have primarily focussed on kinetic hazards such as earthquakes and floods. Drought has a very different signature, with slow onset characteristics, a wide spatial extent, and complex socio-economic effects. SVI studies on drought remain relatively scarce, especially in the developing world context. The present study focuses on Nsanje in Southern Malawi, one of the most deprived Malawian districts and amongst the most vulnerable to climate change. With 89% the population engaged in agriculture, hydro-meteorological hazards, coupled with climate change, environmental degradation and rapid population growth perpetuate the disaster-poverty cycle. This study was conducted during the 2016 drought when the region was in a state of food emergency. Due to the unstable nature of Nsanje's food system the population are frequently dependent on aid, as donor resources are finite it is crucial to understand where resources can be best targeted. The objective of the paper is to develop and test an index assessing the relative social vulnerability of communities, identify the causes of vulnerability and the plot their spatial variability. This will allow the operationalization of drought theory for the efficient targeting of assistance. Using a questionnaire with structured and semi-structured elements, focus groups were conducted in 34 villages spread across the district. Participants represented local development structures, disaster management committees and regular community members. The study results emphasize the livelihood reliance of Nsanje on subsistence farming. Vulnerability arising from crop sensitivity is lowest in the Eastern regions of the district, adjacent to the Shire River. Adaptive capacities scores were higher in western areas of the district. Animal sales are an important component to the adaptive capacity of communities, allowing income during crop failure. Feedback from the communities indicates access to riparian marsh land is of critical importance during drought. Many marsh communities however did not report sufficient levels of historical food security. The causes of this instability are largely due to destruction of crops and animals by flooding, particularly the catastrophic 2015 Shire floods. The development of a drought specific SVI is challenging in multi-hazard environments such as Nsanje, particularly in the context of a hydrological system prone to extremes of drought and flood. The research presented here is relevant to decision makers in planning and implementing humanitarian interventions in the area. The findings of this study call for greater emphasis to be placed on developing methodologies which aim to understand social vulnerability to drought within multi-hazard framework. This is particularly important in the case of hydro-hazards where climate change is exacerbating the extremes of the hydrological cycle.

Keywords: Africa; drought; Malawi; social-vulnerability index; multi-hazard.

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## Resilience rediscovered: a critical review in the context of disaster resilience at community level

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Resilience is the ability to go back quickly to the normal state of the system and in a better state as well. The study aims to provide a general understanding of resilience from different fields through critical reviews of journal articles. The common phenomenon in all the definitions stated is the presence of disruptions and recovery. The paper enumerated examples of models of resilience in order to examine their inherent properties. Most of the paper reviewed enumerated strategies to be resilient and it leads to the characteristics of flexibility and diagnostic process. Then a propose resilience framework was developed to summarize the set of ideas and practices that promote resilience. Identifying specific situations which applies the formation of resilience as seen in the proposed conceptual framework is a key to set the boundaries of systems of interest. The study adopts the key framing questions: 1) Resilience of what? 2) To what? 3) For whom? Resilience of local community to geo hazards disruptive event forms the boundaries of the study. It is intended to all stakeholders of the community such as the disaster managers, the local government, local residents in the community and non-government organizations. These are the ones who would decide on taking actions in implementing resilience in the community. Lastly, the paper does not analyse the resilience merely to get to understand them better but with a view to take actions on resilience more closely.

Keywords: resilience; disaster resilience; community level; critical review.

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## Comparative analysis of social indicators from the vulnerability cartography between two Brazilian cities

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The objective of the research was to conduct a comparative study on the spatialization of social vulnerability in the area of urban censuses of two Brazilian municipalities: Bragança Paulista (SP) and Campos do Jordão (SP), using a simplified indicator of social vulnerability. After reviewing the literature, we selected 12 subjects of variables as quantitative selection data for the demonstration of a simplified indicator of social vulnerability. We also verified, in reports provided by CENSO 2010, nine variables that relate to the following thematic axes: Education, Ethnicity, Gender, Age, Income, Living Condition, Characteristics of Residents, Infrastructure and Basic Services. After a collection and tabulation of these data, we created a spatialized index so that we could represent the vulnerability in the two areas of study. The concept of risk has innumerable meanings and those differ according to the field they are applied to. Thus, risk can be synthesized as the knowledge of the disturbances caused by an event that can affect an individual or community, so the risk is social. The concept of vulnerability has a well-defined meaning within scientific knowledge, although it is used and appropriated by different fields of knowledge, being generally related to risk studies. Its definition within common sense conceives it as the weak side of a subject or issue and as the point where someone or something can be hurt and / or attacked, sometimes being used with the same sense of weakness. Through the elaboration and analysis of social vulnerability in the cities studied, we observed the areas that are considered the most vulnerable and those with the lowest vulnerability, which allowed establishing the patterns of urbanization that impelled and stopped these processes. The spatialization of vulnerability showed a tendency to the central areas of cities with low vulnerability and peripheral areas with high vulnerability obeying the center-periphery opposition pattern. The methodological approach presented provides a simplified mechanism from the main indicators of vulnerability considered for the comparative study of two geographically similar areas. They can be used to create a vulnerability index that provides local and regional information from different geographic areas, aiming to identify vulnerable communities. Finally, it became possible to observe areas that are more or less vulnerable, which allowed us to establish urbanization patterns that impelled and stopped these processes. The spatialization showed low vulnerability in central areas and high vulnerability in peripheral areas, obeying the opposing-pattern center-periphery.

Keywords: socio-environmental vulnerability; cartography, Campos do Jordão (SP), Bragança Paulista (SP).

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## Natural disasters and human development: linking exposure, vulnerability and resilience concepts through the geography of floods

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The concepts of natural disasters and human development interlock to form the base of discussion concerning the socio-economic and environmental consequences of extreme natural events. The tragic nature of such episodes has strengthened debate about the level of development in relation to the exposure and vulnerability of local populations to natural disasters. If the geographical distribution and frequency of extreme natural events (earthquakes, hurricanes, floods, droughts) can be explained through the vulgarities of the natural characteristic of a region, then economic damage, loss of life and prospects for reconstruction shows us a geospatial distribution that follows the patterns of human development. The localization and the study of reoccurring natural disasters such as floods are particularly useful for the analysis of the relationship between human development, vulnerability and resilience to a natural catastrophe. Furthermore, the forecasting, management and response to the ever-increasing number of major floods, has highlighted differences between wealthy and poor countries. This study uses worldwide flood data in the three last decades to explore the relationship between the level of human development and the degree of vulnerability of populations at risk of natural disasters. Through the analysis of data and mapping the floods occurrences, the study tries to answer the questions related to the linkage between exposure to hazard, social vulnerability and resilience.

Keywords: human development; natural disasters; floods; vulnerability; resilience.

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## Rethinking resilience in the context of natural hazards: towards an agency-centred approach of resilience

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Communities in remote mountain regions in the Global South are highly vulnerable to natural hazards with numerous scales of impact, durations and effects and often vague future dynamics due to global climate change. The ability of local people to proactively cope with, adapt to and transform in the face of hazard processes is a major parameter of resilient mountain development. While resilience-based approaches have been widely analysed, there come several issues with its use. Resilience is mostly used as analytical concept being measured by quantitative methods using selected indicators as proxies. However, measuring resilience is rooted on the idea of benchmarking which assumes that people are homogeneous, rational agents with the same abilities and willingness to act. Classical resilience analysis implies the formulation of a desired outcome one wants to strive towards and which can be measured. But while certain outcomes may be perceived as desirable for some, they might not be for others. It is not obvious what a desirable outcome to strive towards is, nor what should be done to reach it. Most research has not adequately addressed these issues. The purpose of this paper is to introduce an agency-centred perspective on resilience. Specifically, we propose a conceptual framework which analysis the logic of existing agency arrangements considering social, political and historical structures but also cultural worldviews and personal values and beliefs. We critically discuss conventional conceptualizations and operationalizations of resilience. Empirical findings from two country specific case studies from Nepal are presented, which are based on quantitative surveys and qualitative interviews from 2017 and 2018. We challenge classical approaches to ‘measure resilience’ in remote mountain regions in the Global South and argue why the focus on benchmarking pose a major shortcoming of conventional resilience assessments. We present findings that capacities to cope, adapt or transform in the face of natural hazards need to be addressed individually. The agency-centred perspective on resilience is the starting point of this research; agency is perceived as combination of being able and willing to act in the face of natural hazards. While the subjective ability to act is influenced by external factors such as access to assets, the willingness to act is shaped by individual goals and trade-offs which are inter alia rooted in cultural worldviews, values and beliefs. A deeper understanding of individual agency arrangements is a requirement for understanding resilience to natural hazards. In developing practical recommendations to increase resilience, we need to better understand people’s agency and recognise their priorities and decisions. By closely examining these interlinkages between cultural worldviews, personal values and beliefs and existing agency arrangements, we contribute to a more holistic approach to resilience.

Keywords: benchmarking; mountain regions; resilience assessments; agency; Nepal.

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## Measuring the unquantifiable?

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Many seek to qualify the meaning of resilience, with the UNISDR defining resilience as “The ability of a system, community or society exposed to hazards to resist, absorb, accommodate, adapt to, transform and recover from the effects of a hazard in a timely and efficient manner, including through the preservation and restoration of its essential basic structures and functions through risk management”. If resilience is becoming qualified through this definition, one might ask: can it be quantified? Or should it? Defining strategies and metrics for resilience has led to a new generation of measurement frameworks but what are they measuring? The European Commission states that 98% of cities are experiencing the effects of a changing socio-ecological environment with increasing urban populations, risks associated with natural hazards and human-induced threats, urban resilience is imperative. With such a large proportion of people living in cities, it is perhaps odd that, so few resilience frameworks explicitly deal with cities. Five frameworks measuring urban resilience are identified: IIED’s Tracking Adaptation and Measuring Development, BRE’s 12 cities assessment, Rockefeller’s City Resilience Index, UNISDR’s Making my City Resilient Campaign (MMCRC), and the Ecological Sequestration Trust’s ‘Resilience.io’. This paper thematically analyses what interpretation of resilience is being measured, to consider whether different risks are being amplified through different frameworks and whether sustainable development has a role in building transformative capacity, with five key themes: 1) Each framework has its own version of measuring resilience through either an index or a checklist; is the quantification of urban resilience leading to indexing cities for risk, or to support capacity building over time of a particular city? 2) Key themes occur between the collated indicators on governance, society, ecosystems, ‘design and planning’ actions but risk needs further assessment and civic planning should be more involved in decision making. 3) Frameworks themselves are risk management tools but of what? An index of risk? Risk can be reduced through sustainable development and more collaborative approaches in the built environment. Sustainability is not formally recognised but is being used indirectly. 4) Who is owning the risk? If cities become indexed for risk, what does it actually meant and where does it lead decision makers? Does it take a disaster to own it? 5) Resilience may be measurable through indicators but it remains to be quantified as these processes are happening. Do we have the measure of it? Are risks being amplified? This paper highlights that measuring urban resilience in frameworks would benefit from more unification between operational led (City, BRE and Resilience.io) and policy organisations (MMCRC and IIED). This paper has established that a version of city’s resilience has become quantifiable through indicators to establish a baseline, but is it really leading to transformative adaptive capacity of design and urban planning in our cities?

Keywords: measurement frameworks; risk; city; resilience indicators; thematic analysis.

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## TRACK 1C

### Understanding risks linked to climate change

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## Damaging flood risk in the Portuguese municipalities

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Modeling and understanding the impact of climate change on flooding processes in Mediterranean climate areas, namely in southern Europe, is a complex endeavor, which must also consider exposure and vulnerability patterns. Assuming that vulnerability plays a relevant role in explaining the degree of loss due to natural hazards, the present research compares a flood-susceptibility index with a social-vulnerability index and a historical record of flood losses, both aggregated at the municipal level. The purpose of this research is to define municipal flood risk profiles that would rank the 278 municipalities and contribute to the strategic allocation of resources and flood risk management. A simplified method for assessing flood susceptibility for mainland Portugal was applied considering three inputs, highlighting the relevance of flooding past evidences: distribution of alluvial deposits, Floods Directive mapping and a 100-yr flood hazard map provided by LNEC. Further, the percentage of flood susceptible areas per municipalities was computed in order to obtain the municipal flood susceptibility rank. Social vulnerability at the municipal level was assessed combining the dimensions of criticality and support capability. Criticality refers to the individual and household characteristics that define the expected degree of loss and the ability to recover (e.g. age, education and income). Support capability refers to the territorial context in terms of civil protection, health, education and other infrastructure that contributes to reduce the flood impact and facilitate community's recovery. For each dimension, scores resulting from PCA were multiplied assuming that support capability acts as an attenuating factor of criticality. Historical losses caused by damaging floods were extracted from the DISASTER database, querying only the records related to floods collected for the period 1865-2015 in mainland Portugal that caused fatalities, injured, homeless and evacuated people. This work contributes to the discussion of the spectrum of combinations of flood susceptibility, social vulnerability and past flood disaster events at the municipal level. The highest scores of susceptibility (those above the 90<sup>th</sup> percentile) are found on the 14 municipalities located along the downstream areas of the Vouga, Mondego and Tagus basins. These municipalities are also those where the highest number of cases and the highest impacts in terms of displaced and evacuated persons were registered in the historical record of flood losses. The municipalities along the Tagus and Sado rivers present high criticality and are among those with large portions of their territory with a high susceptibility index to floods (respectively, 9, 19 and 15%). Regarding support capability, the overlay of low scores with high susceptibility is found along the Tagus and Mondego basins. Considering the final score of social vulnerability, Chamusca and Coruche, in the lower Tagus basin, are the municipalities with simultaneously high scores and high susceptibility. A more thorough cross-analysis is made possible if the principal components of both criticality and support capability are considered. Such outputs, when crossed with flood susceptibility are able to identify the specific drivers of social vulnerability (e.g. mobility), upon which, stakeholders may act in reducing flood impacts.

Keywords: flood susceptibility; social vulnerability; flood losses; municipalities; historical records.

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## Climate-related disaster challenges for sustainable development: innovating a science and policy framework towards sustainable and climate-resilient Quezon City, Philippines

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The extreme weather event Super Typhoon Haiyan devastated portions of Southeast Asia, particularly the Philippines, on November 8, 2013. It served as a wake-up call for urgent action by the Philippines and other Island-States to mainstream Climate Change Adaptation (CCA) interventions. In addition, cities in Southeast Asian Archipelagos (Philippines, Indonesia, and Malaysia) and Small Island Developing States (SIDS) have distorted the natural environment by haphazardly constructing roads, buildings, and other infrastructures. Such massive changes in the environment are altering the ecology, creating sustainable development challenges such as local flooding that cause physical and psychological illnesses to those affected. To prevent these impacts and make urban areas and Island-States Climate Change (CC) resilient, there is need to mainstream CCA at very early stages of development planning. Thus, to achieve this objective, the Quezon City Local Government (QCLG) took an initiative to craft a Science and Policy Framework (SPF) in order to develop its sectoral-based CC Action Plan that can be mainstreamed in its comprehensive development plan. It was done by operationalizing the 4<sup>th</sup> of eight Guideposts of an existing Risk-Sensitive Comprehensive Land Use and Development Planning Model, which consists of step-by-step technical procedures on how to develop the outline of the SPF and conduct periodic strategic planning workshops using gender-sensitive participatory process. Thus, the SPF, as an innovative risk assessment approach, was applied in generating primary data about hazards characterization, exposure to elements at risk, and threat levels. Essentially, it allowed to assess impacts of climate-related events/hazards (Extreme Weather Events, Change in Rain Patterns, and Rise in Mean Temperature in context of Quezon City) on five local development sectors: Social, Economic, Environmental, Land Use/Infrastructure, and Institutional; intersecting with seven CC priority areas: Food Security, Water Sufficiency, Ecological Environmental Stability, Human Security, Climate-Smart Industries and Services, Sustainable Energy, and Knowledge and Capacity Development; aligned with the Philippine National Framework Strategy on Climate Change 2010-2022. In addition, Geographic Information System (GIS) was also used to process acquired pertinent data to analyze climate projections and develop spatial strategies for decision making. The results generated revealed the level of personnel and institutional adaptive capacities, threat level of CC related hazards on development sectors and personnel and institutional relative vulnerabilities. Further, projected casualties, economic losses per capita, and gastrointestinal infection rate were also determined considering no intervention scenario. The entire operation eventually allowed QCLG Technical Working Group to prepare its Local Climate Change Action Plan (LCCAP) 2017-2027 comprising of development sectors' and CC priority areas' cross-cutting Programs, Projects, and Activities (PPAs) with corresponding budget/agency and timeframe. The appropriate application of the LCCAP will ensure the sustainable development and climate-resilience of Quezon City. The above SPF and Action Plan are flexible and fashioned toward enhancing key development sectors in order to create sustainable and CCA-resilient Cities and SIDS. They can also be considered as globally-effective tools for achieving the Paris Agreement, Sustainable Development Goals, and targets of the Sendai Framework for Disaster Risk Reduction.

Keywords: sustainable development; adaptive capacity; relative vulnerability; hazard threat level; climate resilient.

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## Exploring sources and receptors of health impacts of drought in the UK: a narrative approach

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The health impacts of drought have been found to be wide and varied affecting human populations through reduced water quantity, water quality, food security, dust and air borne pathogens, mental health and well-being, among others. Research in this area is still in its infancy with only a few studies on the global health impacts of drought. The extent to which a population is vulnerable to the impacts of drought is dependent on underlying development factors including the security of water resources and supply systems and the health sector. As a result, less developed countries have been found to experience more frequent and severe impacts of droughts compared with developed countries. Nonetheless, developed countries like the UK have in the past been affected by several droughts of varying intensities and are expected to be affected by drought due to climate change implications for extreme weather. Climate change projections for the UK imply that droughts will become more frequent and severe in the future. This therefore highlights the need to understand how drought might affect future populations and how resilience planning might be integrated. This paper hence seeks to explore, through narratives, the health impacts of past droughts in different parts of the UK and future expectations. Participants in six catchments across England, Scotland, and Wales were interviewed using a non-structured format. These interviews were recorded, transcribed, and developed into digital stories. These digital stories provide narratives of drought impact for health with focus on private water supplies and mental health and well-being. The most noticeable impacts of drought are on mental health and well-being of various receptors such as farmers, private water supplies, and those involved in outdoor recreation. The impacts on these receptors stem from several pathways that are usually linked with diminished water quantity and quality. Although drought might appear to have only negative connotations, it is also expected that drought will likely present several opportunities for enhancing access to certain outdoor recreation activities such as walking, hiking, sports, cycling, among others, all of which have been linked with positive health outcomes and positive mental health. This work presents the first comprehensive assessment of drought implications for health in the UK and has applied a unique approach of using narratives to investigate these impacts. More detailed assessments are needed to better understand the linkages and pathways through which drought might present health impacts into the future particularly under climate scenarios. Furthermore, a joined up narrative-science approach may prove integral to future projections of drought impacts in the health sector as well as other sectors and hence in encouraging and enhancing people's capacities to build their resilience to drought.

Keywords: drought; health; impacts; mental health; resilience.

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## TRACK 1D

### Bushfire risk: the natural and social components of the equation

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## Humans play a crucial role in coproducing regulating ecosystem services: the case of forest fires in the Carmel-Haifa Region

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In recent decades, we have witnessed an increase in the number and extent of catastrophic forest fires worldwide. In the Mediterranean area, the number of forest fires and the total area burned has been increasing since the 1960s. Israel's Carmel area has experienced numerous forest fires, including the largest in 1989 and 2010. In November 2016, the adjoining city of Haifa suffered its first large fire at the wild land-urban interface. Haifa sits on Mount Carmel and its built area is interspersed with numerous wadis (dry river beds) which are underdeveloped, vegetated corridors. In the aftermath of the 2016 fire, as for the previous events, resources were channeled towards responding to the fire damage and increasing firefighting with little attention to adapting the social-ecological system to future potential risks. Ecosystem-based approaches for reducing disaster risks have been overlooked which continues to contribute to the overwhelming scale of fires in the area. We define ecosystem services and disservices for fire regulation. We then analyze historical, pre- and post- fire forest management practices in the Haifa and Carmel region through the study of reports, scientific articles and policy documents and expert' interviews. We focused on how afforestation practices altered ecosystem traits, such as vegetation uniformity, lack of diversity, high presence of invasive species and dense vegetation that affect fire risk. Ecosystem disservices, which in this case principally refer to increased fire risk brought on by widespread afforestation using Aleppo pine trees (*Pinus halepensis*), carried out to greening the Carmel region and beyond, are socially constructed, as would be potential fire regulating services. We suggest that intensive afforestation, interspersed with neglect, inadvertently increased the risk of forest fires, by introducing ecosystem disservices. In contrast to this, sustainably managed ecosystems provide fire regulating services and are less susceptible to large fire events. We derive from the experience of the fires in the region that risk reduction, via embellishing regulating services, necessitates active human management and restoration to more locally diversified and adapted systems. In the Haifa-Carmel region, forest fires are the result of allochthonous ideas of nature and resultant maladaptation to the local ecological and climatic conditions, leading to ecosystem disservices. In urban environments, human intervention, in supposedly "natural" areas, is needed to restore and enhance regulating function of social-ecological systems. We suggest that human capital should become an integral part of the description and definition of regulating services and disservices, particularly regarding fire risk. Neglecting the importance of human capital in ecosystem services and that looking at ecosystems as something that is fixed, "out there" and little subject to human intervention can instead produce risk. We stress that, in the expanding fields of ecosystem-based disaster risk reduction and climate change adaptation, we need to move from a description of services as "gifts of nature" to one requiring and integrated social-ecological-technological framework, if we aim to reduce risk, especially in and around the urban setting.

**Keywords:** forest fires; social-ecological systems; urban areas; ecosystem services and disservices; ecosystem-based disaster risk reduction.

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## Guidelines for increasing resilience of informal settlements exposed to wildfire risk

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Internationally, there is increasing concern with the development of improved ways of dealing with disasters (UNISDR, 2015). Wildfires (also called bushfires in Australia) bring about greater disaster risks at the urban-rural interface of wildfire prone areas, where lives and properties are more exposed. Usually, these risks are even greater in contexts of informality, where settlements have been built with little consideration of risks. The aim of this paper is to report on the production of guidelines to develop resilience to wildfires for communities living in informal settlements exposed to wildfire risk. The investigation is approached through action research. It is the result of a collaboration that took place between academics, public servants, professionals and community representatives of Agüita de la Perdiz in Concepcion Chile, within the context of the seminar ‘Prevention of Forest Fire Risks in Urban Settlements and Buildings: a Planning and Design Approach’ organized by the Universidad del Biobío and the *Nodo de Arquitectura Sustentable* in Chile and facilitated by experts from the University of Melbourne and Bushfire and Natural Hazards Cooperative Research Centre (BNHCRC) from Australia. Agüita de la Perdiz is an interesting case because it is an informal settlement with ongoing wildfire risk where the local community is engaged in mitigation activities. The product of the seminar and the participants’ discussions and analysis were condensed in a set of guidelines structured in two main sections: (1) general principles that influence the behaviour of fire and house destruction; and (2) applying the principles by analysing wildfire risk and developing a design response. The first section describes the key elements that influence fire behaviour in a typical forest and how this translates to principles of house destruction. The second section elaborates on understanding risks at different scales and on identifying likely fire behaviour in a specific location and context. This then forms the basis for development of a design response that identifies key actions for houses, the site, and settlement improvement and community development for house and community survival. These guidelines – and the process of producing them – will contribute to the dissemination of knowledge about general design and planning strategies to mitigate wildfire risk, as well as to build local capacities. Furthermore, it is argued that the collaborative process undertaken to develop the guidelines is replicable in other places to address context specific issues. The report was written in lay-language, generally accessible to a wider audience, and is complemented by clear graphics that communicate core principles. This case demonstrates that there are certain core scientific, methodological and professional principles that can be transferred to other settings. However, understandings of the range of locally particular aspects of hazards and resultant risks need to be developed locally, in parallel with solutions themselves that are relevant to local communities. This is particularly relevant in the case of informal settlements with a strong desire to maintain local autonomy, while maximising the benefits of local municipal assistance in terms of legal, financial and coordination facilitation.

Keywords: wildfires; local communities; urban planning; informal settlements; community engagement.

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## Disaster Risk Reduction beyond command and control: mapping an Australian fire from a complex adaptive systems' perspective

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Urban and regional resilience is taking centre stage amidst growing concerns with environmental change and associated increased frequency of natural hazard events. In parallel, disaster risk reduction has grown as an area of inquiry and action, particularly within the fields of emergency management and natural hazard mitigation. This paper examines challenges and opportunities of employing resilience theory in the context of bushfire disaster risk reduction by examining the case of the Australian coastal town of Wye River on the Great Ocean Road, Victoria – located in a forested and highly fire-prone area, with limited evacuation options, having experienced a devastating wildfire in December 2015 during a peak tourist season. The research informing this paper draws on the study of the evolving concept of resilience and its incorporation by different academic disciplines and government agencies through policy formulation and implementation in Victoria, Australia – one of the most bushfire prone areas in the world. Data collection involved access to academic texts, government documents, legislation and social media related to the 2015 Wye River-Jamieson Track fires. Data were analysed following a Grounded Theory approach supported by qualitative research software – NVivo 12. Findings point to the emergence of an approach that emphasizes emergency management services and the resilience of local communities. Among the challenges of employing resilience theory in the context of disaster risk reduction is the use of the variant word resilient, contradicting the primary foundation of risk and resilience conceptualisation – their relativity to complex conditions and events yet to occur and not fully predictable and understood. This translates as a challenge, because reduction of potential consequences of events requires comprehensive approaches, concerted action and effective communication that rely on the use of clear and meaningful terminology that can be understood in a similar way by the parties involved. Identified opportunities include the employment of resilience from a perspective of nested systems, resulting in understandings of community resilience as related to social structure resilience, reinforcing the idea of shared responsibility between institutional structures and communities. Additionally, the importance of natural environment restoration to post-disaster community mental well-being brings an opportunity to build social-ecological resilience as part of community resilience – even if from an anthropocentric perspective of the environment being the provider of ecosystem services to human needs. It was concluded that, despite advances to date, the Australian system still lacks a comprehensive approach to natural hazard mitigation as part of urban and regional planning arrangements, there being room for integration of different knowledge domains to reconceptualise resilience and facilitate comprehensive inter-agency concerted action for better natural hazard mitigation and greater local community and environmental resilience.

Keywords: disaster risk reduction; resilience; emergency management; Wye River; bushfire.

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## Wildfire risk awareness and preparedness of predominantly Māori rural residents, Karikari Peninsula, New Zealand: a foundation for building community resilience

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Communities in Aotearoa New Zealand frequently experience a variety of natural hazards, including earthquakes, volcanic eruptions, tropical cyclones, floods, snow storms, landslides and wildfires. Natural hazards cannot be predicted, but events like wildfires which are relatively numerous (about 4100 small wildfires annually) provide an opportunity to explore community resilience. Wildfires have had a greater effect on rural communities in recent years, with 16 homes lost in rural fires throughout New Zealand during the 2016-2017 fire season, the greatest number lost in 100 years. With climate change likely to bring increasing temperatures and more severe drought conditions to drier areas of the country, further increases in wildfires affecting rural and wildland-urban interface communities are anticipated. This paper focuses on the risk awareness and preparedness of residents for a wildfire in the Far North, New Zealand Aotearoa. A remote rural community on the Karikari Peninsula has experienced repeated wildfires following the unsafe use of fire by residents. The small community (730 residents, 2013 Census) was affected by a human-caused wildfire in 2011 which destroyed three homes, nine ancillary buildings and approximately 145 ha Māori-owned farmed exotic grassland and shrublands and two local residents lost their lives in the response. A qualitative study was completed 3.5 years after the wildfire focusing on local Māori residents. Following dialogue with agency staff and fire force volunteers in 2014-15, we conducted semi- structured interviews and a focus group in May 2015 with 25 community members (22 Māori) who had been directly affected by the 2011 wildfire. We found that participants possessed a high level of awareness of the local wildfire risk which was directly related to their understanding of the local environment, past wildfires, attachments to land, information passed down within Māori whānau (extended families) and the local rural fire force. Awareness of the local wildfire risk, attachments to land, and efforts by the local fire force and residents influenced participants to undertake preparations to use fire safely, carry out wildfire prevention initiatives and reduce the impacts of anticipated future wildfire events. The heart of community resilience centred on the strong whānau and connections within the local hapū (subtribe) ensuring that the community worked together and supported one another, particularly following the significant wildfire experience within their community. An increased understanding of fire awareness and preparedness by Māori residents and the broader community will aid fire authorities to work with the community to design strategies to build community resilience to future wildfire and other natural disasters.

Keywords: indigenous community; wildfire experience; preparedness; awareness.

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## Integrating the principles of adaptive governance in bushfire risk management: a case study from the South West of Australia

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Bushfires, and their interconnected social, economic and environmental impacts, are one of Australia's most pressing disaster issues. Australia has a long history of bushfire management, which dates back around 50,000 years when Aboriginal people first applied fire in the landscape (Bowman, 1998). However, this century, Australia has experienced a number of extreme bushfires, resulting in loss of life and property. Given predictions that bushfire activity will increase due to climate change, the governance of bushfire management is receiving considerable attention across the disaster, natural hazards and planning fields (Melo Zurita, Cook, Harms & March, 2015). There is a growing imperative to address bushfire risk in wildland urban interface areas (WUI), which in the South West of Australia (SW), despite being highly fire prone, are experiencing the greatest population growth (Anton & Lawrence, 2015). The expansion of settlements into bushland areas, which have ecological value, raises many complex governance dilemmas regarding human safety, asset protection and biodiversity conservation (Bardsley, Weber, Robinson, Moskwa & Bardsley, 2015). Developments in Australian bushfire management policy reflect the broader international disaster policy trends of building resilience and reducing risk, as emphasised in the Sendai Framework for Disaster Risk Reduction (UNISDR, 2015). A number of resilience focused, risk- based policy measures and regulations are being implemented across Australia to reduce the threat of bushfires (March & Rijal, 2015). There is however growing concern that mitigation measures, which rely on metric risk assessment, have limitations in their ability to address the inherent complexity and uncertainty associated with contemporary disaster events (Cavallo & Ireland, 2014). Quantitative risk-based frameworks have been critiqued for focusing too narrowly on regulation and failing to engage the diversity of stakeholders needed to effectively govern risk (Renn & Klinke, 2013). Furthermore, there is concern that the current bushfire risk management model has possible environmental and cultural implications that need to be better understood (Moskwa, Bardsley, Weber & Robinson, 2018). Adaptive governance is a theoretical framework which has emerged in response to the limitations of command and control management regimes and in cognizance of the complexity and interconnectivity of contemporary socio-ecological issues (Chaffin, Gosnell & Cosens, 2014). Based on a literature review, this paper will develop a set of key principles for adaptive governance relevant to the field of bushfire risk management. Using these principles, a case study of the South West of Australia, a bushfire prone region with high biodiversity and cultural value, will be presented. Using mixed methods of policy content analysis and in-depth, semi-structure interviews with key stakeholders in the South West bushfire management sector, this paper examines the extent to which the current Western Australian policy setting enables the adoption of adaptive governance principles. Moreover, this paper explores how societal worldviews influence policy and management priorities and hence the ability of the sector to apply adaptive governance principles in practice. The paper concludes by suggesting governance mechanisms that could assist the bushfire management sector become more adaptive in its approach.

Keywords: bushfire management, adaptive governance, disaster, risk, resilience.

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## Risk management for forest fire in a World Heritage site: vulnerability and response capacity by Rapa Nui indigenous community

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The World Heritage Site Rapa Nui National Park located in Eastern Island is actually affected by several natural, environmental and anthropogenic threats. These threats endanger the preservation of the Outstanding Universal Values (OUV) of the Site, in addition to the negative impact on the population. The insular condition of the Site, located at 3,700 kilometres from the Chilean coast, appears as a factor of vulnerability due to the potential limitation of resources to face a disaster. For this reason, the local indigenous community (Ma'u Henua), which is in charge of the Site management since November 2017, is a key actor in disaster risk management. Assessing the response capacity of this group, in coordination with other actors, is one of the objectives of this research. Under the potential threats in the Site, the increase in forest fires in recent years has alarmed the local and national community, revealing the need to assess this type of risk in detail. According to the record of the National Forestry Corporation of Chile (CONAFE) more than 100 fires have occurred on the island (163,6 km<sup>2</sup>) between 2010 and 2017. Although the impact on cultural heritage has not been determined, these fires have affected archaeological and environmental heritage, as well as social and economic impact due to the effect on productive activities. This research concerns the assessment and proposals for actions to reduce vulnerability and improve responsiveness to forest fires on the island, considering the role of the indigenous Rapa Nui community as a focus. For this purpose, a record of the different groups associated with site management was performed, showing its characteristics, the relationship between them, and capacities for risk management. Likewise, vulnerability factors were identified and evaluated, as well as their impact on the OUV. In particular, fire of September 2017, which affected more than 150 hectares, was analysed, stating how the community's capacity for organization was, available resources, and response from both the island and the continent. The diagnosis and analysis of data allows identifying on the one hand the opportunities that emerge from the new administration led by a committed local indigenous community. However, critical aspects appear in the response system, which are derived from lack of articulation between the different groups, lack of installed capacities, lack of protocols, lack of resources, among others. The significance of the cultural heritage for the current Rapa Nui community was also investigated, due to the close relationship it has with the preservation of the Site. Finally, a model for forest fire risk management for the preservation of the OUV was proposed that considers the knowledge of the local community, its relationship with its cultural heritage and the other groups that are in relation to the site.

Keywords: world heritage; forest fire; indigenous community; responsiveness; vulnerability.

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## Urban planning of interface zones in towns located in the area affected by the mega fires of 2017 in Chile

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Forest fires that occurred in the centre-south of Chile in January and February 2017, affected over 500,000 ha and 7,623 people, between the regions of Coquimbo and Araucanía, causing damages for 550 million dollars. An important part of the affected area corresponded to the so-called “secano interior” (interior dryland), located on the eastern slope of the Cordillera de la Costa, with medium to low mountain ranges and narrow valleys with streams near to which several towns of around 2000 inhabitants are located, providing facilities and services for rural population, which is mainly engaged in agricultural and forestry activities. The fire occurred during the hottest January recorded so far, with temperatures above 30°C, strong winds and low humidity, along with abnormal water stress due to a prolonged drought, the difficult geography and the existence of predominant monocultures plantations, native forests, shrubs and grasslands, all of which contributed to the rapid expansion of fire. In the current scenario of climate change it is likely to expect that these conditions may repeat, so a new mega fire is possible. Communes located in the interior dry land of O’Higgins and Maule regions were the most affected, being defined as study area. In particular, the location of populated centres in relation to wildfire hazard, as well as instruments and policies of urban planning and design, especially at the interface zones, are explored through an analysis of planning instruments currently in force and updated proposals, as well as the revision of the reconstruction process and legal framework, in addition to interviews to key institutional actors. The absence of regulations specifically related to interface areas in urban planning and forestry projects was observed. The sectoral vision and institutional capacities are limited, and actions focus on the management of forest fires risk itself without considering the relationship of these areas with pre-existing or new population centres, ignoring the importance of these small towns for the rural population that is territorially dispersed, being those people the more affected because of the fires. Current strategies and efforts regarding prevention and mitigation of wildfires risk are currently focused on monoculture and ecosystems both as threats and as exposed areas, with little consideration of the vulnerability of the population and infrastructure located near them. In addition, the reconstruction process has been oriented mainly to rebuild houses but not necessarily to reduce risk in the existing towns, although some efforts are observed during the reconstruction of Santa Olga, a village completely destroyed due to the fire. Furthermore, both planning and forestry legal frameworks are insufficient for addressing current risk of wildfires that may affect populated areas. A more comprehensive and intersectoral treatment of interface areas should be considered, emphasizing the planning of exposed towns in accordance with the risks that may affect them, including fires. Public and private sectors are involved in land planning and the production or reduction of risks through reconstruction processes, so more coordination is needed to reduce the vulnerability of the interface areas and better manage existing hazards.

Keywords: urban planning; interface zones; minor population centres; integrated Disaster Risk Reduction.

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## Wildfires in Portugal: where and why?

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Fire has been a key tool used by humans for several thousands of years and a vital component in ecosystem dynamics. Uncontrolled fires cause, however, large environmental and economic damages, especially in the Mediterranean region. Nowadays, wildfires rank top of all European forest problems, affecting landscape, wildlife, vegetation, soils, water and air quality, as well as the human wellbeing Portugal has the highest relative burnt area of all southern European countries, between 1980 and 2017. Therefore, several studies have been addressed to the drivers behind wildfires in Portuguese territory, linking them mainly with climate/weather conditions and changes in the landscape mosaic, as a consequence of agricultural abandonment and a marked increase in land covered by shrubs, grass and other light vegetation that is very prone to fire. The association between social and economic vulnerability and wildfire incidence, particularly in terms of burnt area, has received less attention. Based on the assumption that the association between burnt area incidence and socio-economic vulnerability varied geographically, the main goals of this study are: to analyse the spatial patterns of burnt area on a municipal level; to identify the most critical social and economic variables associated with spatial incidence and recurrence of wildfires, by comparing the performance of classical linear regression and geographically weighted regression (GWR) modelling; to map spatial variation in the relationships between social and economic vulnerability and wildfire incidence in order to identify spatial clusters. The results obtained clearly show a strong spatial association between the incidence of burnt areas and some socio-economic variables that contribute to wildfire vulnerability in mainland Portugal. In general, the results demonstrated that the municipalities with high burnt areas displayed high social and economic vulnerability as a result of the higher ageing index and unemployment rates. Conversely, higher income populations and the prevalence of higher livestock densities, namely sheep and goats, influence negatively on the burnt extension. The overlap between socio-economic vulnerability, in terms of low socio-economic status of residents, and wildfire incidence in Portuguese territory suggests a need to evaluate wildfire management policies with regard to social and economic conditions.

**Keywords:** wildfires; socio-economic vulnerability; geographically weighted regression; municipal regression coefficients; Portugal.

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## Australian bushfires: hazards, risk, aftermath, and past and future preparedness

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Bushfires and their spread are caused by natural phenomena and human factors and an understanding of these is critical to managing bushfire risk. Natural hazards include atmospheric conditions, lightning strikes, wind speed and direction and hence fire unpredictability, unmaintained power lines while human factors include arson, outdoor machinery, unattended campfires, ground vegetation and glass litter. Some of these factors can be eliminated or severely reduced by understanding and preparedness for bushfires while others can only be managed in the event. In Australia, risks include lack of training, lack of property preparedness and personal bushfire plans, urban bush fringe lifestyles and lack of understanding and awareness of the nature of the bush and its dangers. Mitigation strategies include town planning (Bushfire Management Overlays and zoning) and building regulations and standards. How does all this work together? Australia is one of the most fire-prone areas of the world. South-east Australia has similar hazard risks to Portugal e.g. hot dry summers and hectares of Australian Blue gums and both are subject to bushfires. Victoria's worst bushfire disaster ever, "Black Saturday" (7 February, 2009) was "a day of unimaginable horror". After 11 years of drought, the native eucalypt vegetation was tinder dry and over 30 fires erupted. In the previous week there were 3 days of over 40°C (104°F) and on the day it was 46.7°C (116.06°F), and less than 4% humidity. The fires "unleashed the equivalent of 1,500 Hiroshima atomic bombs, generating winds of up to 120km/h, (74.5 mph) which snapped trees and created fireballs of exploding gases that surged 600m in 30 seconds. It had enough energy to provide Victoria's power needs for a year. The radiated heat of the 100m-high flames was capable of killing people up to 400m away". Dense smoke reduced visibility to less than 2 metres and survivors remarked on the incredible roar like a jet engine. The fires created their own weather; fire storm and ember attack leapt 40km (24.8 miles; houses simply exploded. The final death toll was 173 persons and countless farm animals, pets and millions of native animals including whole species. Over 1,500 buildings were lost, 4 towns were destroyed - some lost over 1/3 of their population. Suddenly 7,500 people were homeless and 400,000 hectares were burnt. 5,000 volunteers fought 183 fires with a front over 1,000-km long. Despite the excellent preparedness of emergency services personnel nothing could have stopped the fires. Conversely, and despite constant warnings from the Victorian State government in the week which lead up to the fires, some people remained unaware and unprepared and paid the consequences. Many affected areas were scenic bushland towns and with places of local cultural heritage significance. Hearings of the 2009 Victorian Bushfire Royal Commission captured evidence, frequently confronting, which has since shaped Victoria's bushfire management regime. As a result, new building regulations and standards in bushfire areas are in into force to alleviate the risks of the past. More people have their own bushfire plans.

Keywords: bushfire risk; bushfire hazards; building regulations and standards; bushfire plans.

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## The 8<sup>th</sup> ICBR Lisbon 2018 publication outputs and the contributions of the Special Session and the thematic track on Wildfire Risk: Special Issues and Elsevier books

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The presentation focuses on the announcement of a Special Issue of an indexed journal that will be based on a selection of papers presented in the Special Session on Wildfire Risk and in the associated track. The conceptual and thematic framework will be discussed with regard to the 8<sup>th</sup> ICBR's motto – Risk and Resilience in Practice: Vulnerabilities, Displaced People, Local Communities and Heritages –, and taking into consideration the pieces of research submitted in each track. Also will be addressed the possible gaps in the literature produced through the most prestigious journals of the area and how this Special Session could try to fill them. In this sense, considering other publication outputs of the 8<sup>th</sup> ICBR and the goal of addressing some of the timelier and pressing matters of academia, and the social and humanitarian sectors, a first analysis points to the need for launching a call for papers open to the ICBR audience and beyond, to ensure that the goals of this Special Issue are met. Furthermore, in similar terms but in this case looking at the titles and foreseen contents, as well as the expectable larger audience to be achieved, it discusses a possible call for papers for the planned Elsevier books, remarking the differences, in terms of subjects and approaches, of the four books.

Keywords: 8<sup>th</sup> ICBR 2018 publication outputs, Special Issues, book chapters, Elsevier books, call for papers.

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## TRACK 1E

### Risks, vulnerabilities and diversity in the globalized world

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## Multidimensional approach for assessing urban resilience against flooding: a case study of Pakistan

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Urban flooding has become a regular phenomenon in cities worldwide. To reduce flood risks, resilience and its components must be understood. Resilience is used in various contexts and disciplines, and thus diverse methods are used for assessing it. In disaster risk science and climate change literature, resilience is defined in multitude definitions and interpretations, and is known to be overlapped with other related concepts like vulnerabilities, risks, and capacities. This has complicated the process of clear and comprehensive resilience assessment. For successful disaster risk reduction, it is crucial to understand ‘resilience’ and quantify it. The main purpose of this paper is to quantify the resilience indicators and develop a multi-dimensional approach for assessing resilience. Resilience is explored through the lens of five dimensions: social, economic, physical infrastructure, institutional and psychological. This methodology is applied on urban flooding in Pakistan, to operationalize the proposed model. Three cities with different population size situated in high risk flood zones of Pakistan were selected through multistage sampling for empirical investigation. Firstly, Punjab was selected for being the most populous province and frequently prone to flooding. In the last stage, three communities (neighbourhoods) from cities were selected based on frequent flooding, past damages and proximity to flood hazard sources. Rawalpindi (metropolitan) had an urban population more than 1 million characterized by mixed functions. Sialkot (city), with a population between 0.5 to 1 million, and Muzaffargarh (medium town), with an urban population below 0.5 million was selected. Using household survey, a total of 210 samples were collected using random sampling with the share of 70 from each urban community for comparative analysis. An index based approach was developed for assessing dimensions of resilience based on well-defined indicators. Indicators were chosen through extensive literature review for each dimension. An average of these dimensions devised the multi-dimensional resilience index. Households were categorized into very low, low, medium, and high categories of resilience. Statistical tests were performed to identify differences in three communities. Significant differences were observed in almost all dimensions, including overall multi-dimensional resilience index. The proposed methodology for assessing urban resilience against floods was tested, and was found operational. This method can be replicated irrespective of spatial scales, and can be modified for other disasters by streamlining hazard specific indicators. The suggested model can be further enhanced by introducing more relevant indicators at local level for effective assessment of risks. This methodology can highlight relevant course of action for disaster managers and local administrations to assess risk assessment of hazard-prone communities.

Keywords: social resilience; economic resilience; physical/infrastructural resilience; institutional resilience; psychological resilience.

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## Resilience in the Anthropocene

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The Anthropocene emphasizes a new geological epoch of increased human impact on planet Earth. It is filled with complexity and uncertainty and asks for transformative and interdisciplinary responses. Communities all over the world have become more vulnerable and are looking for ways to adapt to global change and increase their resilience. The objective of this study is to bridge the gap between disciplines working on resilience, draw lessons for improved governance of diverse communities in vulnerable areas, and thereby build adaptive capacity in the face of the Anthropocene. We use a systematic literature review of peer-reviewed articles published between 2000-2018 in the fields of human geography, futures studies and systemic design, and examine best practices and lessons learned for dealing with resilience in the Anthropocene. In human geography, the concept of the Anthropocene is seen as arbitrary, as there are different cultural understandings of what causes global climate change: supernatural, natural and human influences. The focus is on a cultural understanding of the Anthropocene and how explanations co-exist in complex ways within and across cultures. While also using the classic geological definition of the Anthropocene, the futures field also increasingly uses the concept as an opportunity to push for sustainability transformations. By inviting communities to futures workshops, participants gain agency over their futures and can develop scenarios rooted in their own existing practices. Engaging with futures work can in turn increase community resilience, which is conceptualized as adaptive capacity, or the potential to adjust to many different future contexts. The field of systemic design emphasizes how today's global challenges are interrelated and therefore require creative and structured innovation approaches. Systemic design tools help to design new relations among entities of a territory, visualize the hidden potentialities, and boost proactive collaboration among local actors. In this way, the method allows territories to be understood in a deeper and wider perspective. Although they use different wordings and disciplinary jargon, human geography, future studies and systemic design all talk about the importance of stakeholder involvement and bottom-up approaches to support improved governance in times of complexity and uncertainty. However, the three disciplines can learn from each other in different ways. Future studies, with its scenario workshops and Systemic Design studies, with its design methodologies, show the importance of hands-on methodologies to address policy-making towards resilient territories and communities. Human geography adds the remark to be aware of our often use of a Eurocentric approach, and the need to go beyond western epistemologies and ontologies. We conclude that the Anthropocene needs transformative, out-of-the-box resilience that combines knowledge from different scientific disciplines with local knowledge and experiences, in a transdisciplinary and holistic way.

Keywords: anthropocene; adaptive capacity; transdisciplinarity; multilevel governance; resilience.

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## Sustainable child-centred disaster resilience education program: participatory action-research study in Bangladesh

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This PhD project involves a study on disaster resilience education for children in Bangladesh within the framework of a participatory action research (PAR) paradigm that also aligns with a child-centred disaster risk reduction ethos (CC-DRR). The primary goal of CC-DRR is to increase children's understanding of the disaster risks in their community and develop their ability to take even a lead role in reducing those risks. Over the last decade, a number of researches have been conducted on different types of disaster risk reduction (DRR) education programs for children. These studies suggest that such programs enable children to be more resilient not only in terms of increased knowledge in understanding risk but also increased preparedness and confidence at both the individual and household levels. However, despite the positive findings, significant challenges still prevail. In spite of generating effective outcomes, the area of development and evaluation lacks a guiding model. This includes one that speaks to both the effectiveness and sustainable implementation. On the other hand, disaster risk reduction education programs for children are mostly designed and implemented by non-formal educators like development and humanitarian agencies. As a result, the literature here is primarily based on the evaluation of programs, such as those of NGOs, many of which have been identified with significant methodological limitations. Besides, in terms of positive outcome, the studies to date typically rely on knowledge indicators and, further, do not identify the explicit elements of the programs responsible for generating specific positive outcomes. Thus, based on the research and reviews to date, this study aims to conduct rigorously designed research focused on disaster risk reduction (DRR) education for children, particularly those that involve children's active input and participation. In doing so, it has the aim of identifying the specific elements of the DRR education programs for children that produce the best DRR and resilience outcomes (as recognised by the children who participated in such programs and the NGO practitioners who are implementing such programs) in understanding risk, reducing vulnerability, enhancing capacity and increasing resilience within their schools, households and communities. Additionally, another aim is to examine implementation factors, including those structural and process factors that facilitate or impede sustainable implementation of such programs in a classroom and school setting. Thus, the study is focused on designing and testing a sustainable child-centred disaster resilience education program that consists of theory, research and stakeholder-identified elements thought to be responsible for generating effective DRR and resilience outcomes and what underpins effective implementation. The study is currently ongoing. The first phase of primary data have been collected in Dhaka, Bangladesh through focus groups discussion with 41 children; interviews with 10 child-centred DRR practitioners from international NGO (e.g., Save the Children, Plan International and Community Participation and Development Bangladesh); interviews with 10 government officials from the Department of Disaster Management (DDM), the Ministry of Education, National Curriculum and Textbook Board (NCTB), Department of Primary Education, Department of Secondary Education; and observation of several CC-DRR program activities implemented by different NGOs in Bangladesh.

**Keywords:** child-centred disaster risk reduction (CC-DRR); education; participatory action research; resilience.

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## Post-disaster recovery as socio-ecological and socio-political construction: responses to the 2010 Merapi eruption as a case study

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The Merapi 2010 eruption was indeed the extraordinary event since more than a century, leading to multiple scientific, political, and social responses and debates to deal with the event and its consequences for the local communities. To understand the complex and dynamic situation of the post-eruption rehabilitation and reconstruction process after the Merapi 2010 eruption, this paper examines the concept of disaster as a socio-ecological and socio-political construct, produced in the sometimes contradictory and even conflicted interactions between different stakeholders and the ecological systems involved. The paper re-embraces the idea that the concept of disaster is relying on who interprets it. It combines a socio-ecological approach seeing man and nature as mutually constitutive and mediated a socio-political perspective to resilience going beyond a bounce-forward approach and a social constructivist understanding of disaster and risk showing how there is no such thing as a natural disaster. The Cangkringan sub-district in Sleman region, the most severely impacted area in 2010, is taken as a case study area, for which data were collected through literature review, observation and semi-structured in-depth interviews with government officials, local activists, local NGOs, academics, political-cultural-religious leaders and members of the local community. The research shows how the Merapi eruption is defined in various ways by various groups, shifting through time and according to various driving factors, and constructed in the dynamics of socio-political and socio-ecological barriers. Local communities are strongly embedded in the Javanese culture and religious-cultural beliefs. Additionally, losing properties such as house, land or cattle were not necessarily nor always considered as a calamity by some of the local communities. Some believe that the Merapi eruption is God's will, arranging the cycle of life, which will bring about good things, especially since eruptions produce massive amounts of sand for the construction sector and newly (re)-emerging economic activities beyond the eruption like tourism. In a way, the government sees this differently and narrowly that produces contradictive and biased argumentations.

Keywords: disaster; risk; Merapi; social construction; governance.

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## Community resilience and collaborative research: some research notes on a case study in the Lisbon Metropolitan Area

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Against the background of a collaborative research that a Lisbon School of Architecture research group began in 2014 through an action research project, which aims to know in a first moment the needs and characteristics of the population and their living conditions; but we also intend to identify the problems and priorities of urban intervention, the pathologies of the dwellings and to search for a sustainable housing solution that is adequate from the urbanistic point of view and from the local residents. It is a precarious and impoverished neighborhood, of illegal occupation, built largely by the residents themselves for more than 50 years. Currently residing in the neighborhood is a population of about 220 people and 53 families, mostly of Portuguese nationality, of African origin and Roma living in a situation of serious precariousness, in poor housing conditions, with low levels of schooling, labor market and low incomes. We are faced with a resilient population and neighborhood very near to central area of Lisbon; in fact, the interviews with the residents reveal that this place is very exposed to socio-environmental vulnerabilities, people deal daily with adverse circumstances, however, people demonstrate strategies to deal with and mitigate the difficulties, revealing ability to adjust and adapt. Community resilience understood as a dynamic process and applied to a collective, from the perspective of Ojeda, La Jara and Marques (2007) the keys to explaining resilience are not found in individual characteristics, but in social conditions, in group relations, in cultural and values of each society. Fieldwork based on observation and interviews has revealed that the empowerment of the association of residents and their representatives, especially women, is correlated with the collaborative dynamic that has been established among the association, residents, University, city council and NGOs. The empowerment and autonomy of the residents has been made in the struggle for recognition of this neighborhood, its residents, also in access to electric light that was cut in 2016, and access to bathrooms and accommodation. We believe that empowerment and collaborative research can enhance these resilient behaviors and attitudes. But also the use of participatory action research and the adoption of strategies of co-production in research aims at the empowerment; working “with” communities tends to provide the communities with greater control over the research process and is a mutual process of learning.

Keywords: community resilience; participatory action; resilient neighborhood; qualitative research; Lisbon Metropolitan Area.

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## Community resilience to natural hazards: a theoretical foundation for developing measurement tool and variable indicators

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The concept of resilience has become a cornerstone for individuals, communities and systems reorganisation to potential damage from natural hazards. One of the consequences of the theoretical development of resilience is the multiple conceptualisation and interpretation of the concept by different scholars. As a result, the progression from conceptual development to a commonly accepted standard for operationalising resilience across different time scales and environment has been a challenge. This paper provides a theoretical foundation for developing measurement tools and indicators selection. Data for this study was from the secondary source. To achieve the aim of this study, an integrated framework of disaster management principle, resilience and community resource was developed to guide indicators' selection; and also, an investigation of studies based on community resilience index (CRI) tool was carried out by this study to ascertain compliance and practical implementation of criteria relating to tool development. Findings indicate that social, economic and physical capacities of an individual are predictive of resilience and limited compliance regarding tool criteria and implementation. The result also shows the difficulty in complying with tool criteria as most assessments are interested in benchmarking and baseline condition of the community under assessment. The result suggests a more participatory approach and the need for assessment to account for the ecological and scalar relationship if the assessment outcome is to reflect the resilience status of a community genuinely.

Keywords: resilience; measurement; indicators; resources; hazards.

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## The concept of resilience in Sweden: governance, social networks and learning

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The concept of resilience is multi-dimensional, multiscalar, and contextualized. This paper outlines the assumptions of a project funded by the Swedish government, aiming at understanding what resilience means in the Swedish local context titled Societal Resilience in Sweden: Governance, Social Networks, and Learning. We also report preliminary results from the first round of case studies in three Swedish municipalities. Global shifts ripple down to the local level, creating tangible consequences for local communities and therefore the unit of analysis for this project is the Swedish municipal level. The three main theoretical fields we take up in this work are governance, social networks, and learning. We investigate resilience vis-à-vis governance because the main criticism of resilience as a concept is its neoliberal character. How does this play out in one of the foremost welfare states in Europe? We research social networks and how they promote (or not) resilience at the local level because network thinking allows us to investigate actors and the ties that bind them. Finally, we take up translational work and interrogate the kind of knowledge production and transfer useful for the promotion of resilience on the ground. The interim and preliminary results we report in this paper concern case studies in the municipalities of Malmö, Örebro, and Arboga, in which, as a first step, we conduct formal social network analysis in the relational architecture of the actors involved in migration issues.

Keywords: social networks; governance; migration; community resilience.

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## Urban metabolism of residential structures

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In the debate on planning for climate change, we tend to propose a compact and mixed-use city paradigm as a sort of universal solution, as it reduces journeys, enables the switch to more collective forms of transportation and this way decreases GHG and energy-source emissions. There are ever more international policies which address efficient and sustainable resource management. The United Nations General Assembly announced its Sustainable Development Goals (SDGs) in September 2015 and adopted the Paris Agreement (COP21) in December 2015, following on from the IPPC Report. Responding to SDG-11 in October 2016, a New Urban Agenda was proclaimed during Habitat III, which is one of drivers of the change that the document defines in order to ‘Adopt sustainable, people-centred, age- and gender-responsive and integrated approaches to urban and territorial development’ is: ‘Reinvigorating long-term and integrated urban and territorial planning and design in order to optimise the spatial dimension of the urban form and deliver the positive outcomes of urbanisation’ (United Nations, 2016, pp. 3-4). These goals lead to many specific questions, such as that on the desired densities, the ideal proportions of open spaces including green ones, the role and extent of transportation networks, etc. The one which is particularly valid is the issue of scale. Upgrading the scale of climate-friendly solutions to that of a neighbourhood, town or region, may bring added values. The urban metabolism models which address flows of resources to and from a settlement should take into account analyses at various scales. Another perspective is the Circular Economy (CE) and the potential for the reuse of resources. Although urban metabolism models usually address flows of energy or water, land is rarely discussed as a resource which should be considered in climate change policies. Nevertheless, the theory of a sustainable urban metabolism applies to land consumption too. Land consumption should be reduced, multi-sourced and the land – recycled and recovered – similarly to other resources; this ‘trias ecologica’ provides the founding principle for the circular economy. Despite the slow pace of its transformations, land consumption may be visualised in the form of a Sankey diagram as a particularly viable ‘urban resource flood’. The praxis of urban planning and design shows many creative solutions for reducing land consumption. Our objective within the current paper is to review the practices of dealing with the densification of residential and mixed-use development. From the point of view of urban metabolism, we are seeking the optimisation of future land consumption. We illustrate our approach with examples coming from urban design practice, this way building a framework for the assessment of urban interventions. The main criteria include density of development, former land use, location, accessibility. After briefly summarising the research into Urban Metabolism (UM) and the Circular Economy (CE), the current paper investigates aspects related to land use transformations. Later, we discuss the examples of land consumption analyses and introduce a methodology of assessment which uses flow analysis – a Sankey diagram. The method is applied to the two case studies coming from the practice of the Dutch firm We Love the City. The research results are then discussed and observations for the improvements of the assessment methods considered and summarised.

Keywords: urban morphology; housing; circular economy; urban metabolism; Sankey diagram.

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## Memory and identity as factors of urban resilience

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The concept of resilience arises for the first time in the 1970s of the last century associated with the work of Holling (1973), on the balance of ecological systems. This concept deriving from ecology has been used in this early century in different areas of knowledge, such as psychology, sociology, biology, and urbanism, among others. The capacity of human beings to resist adversities or, from them, to create a new point of equilibrium, has been the object of study of all these disciplines (Galende, 2004). In the urbanism, the concept of resilience has been applied with greater incidence to urban areas where they occurred, or that are subject to natural catastrophes. In this sense, studies have been developed that aim to create measures to mitigate the impacts that occurrences may have on the built environment, and the ecological structure of the city. It happened in the city of Lisbon with the earthquake of 1755, and it is in the present with the implementation of policies that intend to make the city more sustainable. The urban transformations that have been implemented, both at the level of infrastructures and at the buildings level, have social implications, with an impact on the citizen's lives. This are relegated to the second plan, not even the fact that there is a political discourse that aims the implementation of participatory urban policies - Participatory urbanism. Hence, we are facing a city at two speeds, that of the "center" and that of the "periphery", that of the learned citizens who dominate information technologies and the others. This situation is worrying when we are in municipal neighborhoods with a population of low economic resources and illiterate. We intend with this article, from a case study in the city of Lisbon, alert to this problem. What implications are the urban transformations taking place in the life of the resident population and what measures can be taken to mitigate this situation? In the methodological approach will be used the Case Study or Intensive Analysis method.

Keywords: urban resilience; city; neighbourhood; identity; memory.

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## Building up resilience in the agriculture sector: minimizing the impact of nitrogen fertilizer on water bodies through Grey Water Footprint approach on paddy cultivation in intermediate zone, Sri Lanka

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The fresh-water resources are threatened due to excessive usage of fertilizer and agrochemicals by agriculture. Paddy is the major crop that uses a large amount of fresh water and high amount of fertilizer cause for elevated levels of nutrients as non-point source of pollution in fresh water resources. In this regard, Grey Water Footprint (GWF) is beneficial in understanding the ecological impact and disastrous way of the freshwater pollution. This study was designed to quantify the grey water footprint: the volume of fresh water that needs to assimilate polluted water of rice fields due to the application of chemical fertilizer in irrigated agriculture. A field experiment was carried out in selected locations at the Rice Research and Development Institute (RRDI) in Kurunegala District, which is a major paddy cultivation area in the Low Country Intermediate Zone, Sri Lanka. Lysimeters were used to collect leached water to investigate nitrogen (as NO<sub>3</sub>-N) content which is the most significant and common pollutant in paddy cultivation. Lysimeters were arranged in a randomized block design with three replicates at the upper and lower ends of the site in 2015 Yala season. Fourteen days old rice seedlings of variety BG 358 were transplanted in plots having dimensions of 10 m x 10 m and normal agronomic practices were followed. Drained water was collected from each lysimeter at 7 to 14 day intervals. At the same time the water samples were collected from irrigated flow and from runoff flow at lower end of the field and analyzed for NO<sub>3</sub>-N content. The experiment was repeated in the same plot with same treatments in 2015 and 2016 for four consecutive seasons. The loss of NO<sub>3</sub>-N through leaching accounted for  $8.71 \pm 1.74$  kg/ha (8.4%) for four seasons. The experimental site was well managed with controlled the run-off losses. Hence it was assumed that leaching is the only way of NO<sub>3</sub>-N reaching the fresh water bodies. The GWF of one tonne of rice produced at the research site was created on actual values of leached NO<sub>3</sub>-N amount on experimental data was  $184 \pm 14$  m<sup>3</sup>/t. The estimated leaching run-off fraction ( $\alpha$  value) for N was 0.12208 to the site and GWF was  $187 \pm 33$  m<sup>3</sup>/t. GWF for average leaching run-off fraction (0.1) and constant leaching run-off fraction approach (10% of applied fertilizer N) were  $153 \pm 27$  m<sup>3</sup>/t and  $219 \pm 39$  m<sup>3</sup>/t, respectively. According to the two sample t-test, it was revealed that there were no significant differences ( $P > 0.05$ ) of GWF calculated using different methods except GWF for (average  $\alpha$ ) against GWF (constant leaching) ( $P = 0.037$ ). It was shown that the season, the year cultivated or calculation method have not shown a significantly impact ( $P > 0.05$ ) on Grey water footprint for growing paddy for the selected site.

Keywords: grey water footprint, paddy, nitrate leaching.

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*Theme 2*

**STRENGTHENING DISASTER RISK GOVERNANCE  
TO MANAGE DISASTER RISK**

## TRACK 2A

**Multi-hazard early warning (MHEW): improving availability and access to MHEW, risk information and assessment**

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## Participatory Geographic Information Systems for integrated risk analysis in the outskirts of Arequipa, Peru

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Arequipa is located in the southern Peru and is the second largest city in the country, geographically prone to natural disasters, in particular to earthquakes and floods. In recent years, the Peruvian government has been encouraging risk analysis using Geographic Information Systems, in order to map, classify and quantify the posed danger and vulnerability of risk prone areas. However, due to lack of accurate data and only carrying out a desktop GIS work, these risk analyses results are incomplete and not reliable. This article proposes a methodology that was carried out and tested in the peripheral areas of Arequipa for the development of an integrated risk management model using Participatory GIS (P-GIS) at three levels: identification of dangerous hotspots, modelling of disaster scenarios and urban design for resilience development. Different PGIS techniques are used on each of the stages of this methodology in order to allow more efficient access to information during the four stages of an emergency cycle: response, recovery, mitigation and risk prevention. The PGIS methodology consisted of the following stages: Firstly, the production of participatory social maps, in order to identify the most disaster prone areas, as well as to compare and integrate them with the existing desktop GIS works. Secondly, a mobile application was developed in order to provide real-time risk monitoring information about the occurrence of disastrous events and the improvement of emergency response. Once the most dangerous areas were identified, subsequently, a highly accurate risk model was produced based on the acquired data by an unmanned aerial vehicle (UAV). Finally, a participatory urban regeneration plan was proposed, including the relocation of vulnerable settlements, improvement of accessibility, enhancement of public spaces and strengthening of social resilience.

Keywords: participatory GIS, risk management, Arequipa.

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## Resiliency planning in antagonistic communities

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The basis of this US centric paper will be to discuss how to plan and work with politically conservative and antagonistic communities who are often opposed to land use changes and property restrictions. Planners are well trained to see ways to make the urban form “better” but we often overlook the fact that many people simply do not want we propose. Considering that the US is inherently a suburban nation which takes property rights very seriously, telling a community that they need to curtail certain property rights for the betterment of the overall community is often a daunting task. As the Trump election shows, there are a lot of “smart people” who are out of step with what people think. Planners need to remember not everyone wants to be Portland. Thus this paper will discuss why people in conservatively antagonistic communities think the way they do, often and supporting policies that go against their best interests. The paper will be based in research which centers on resiliency planning, demographic sorting, climate change narratives, anti-Agenda 21 debates, and community empowerment. The theoretical basis of the paper will further be examined through the case study of three politically conservative Lake Michigan communities (Ludington, Grand Haven, and St Joseph MI) who participated in a resilient master planning process. The results of this paper and presentation shows that much of what did to be successful in our planning mirrored the literature. We found: that it was necessary to understand our community before anything began; that the narrative mattered; and that power dynamics and giving power to the community were key to our success.

Keywords: resiliency, urban planning, community empowerment, conservative communities, anti-agenda 21.

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## New multi-scale risk governance and management approach of natural, cultural and artistic preserved areas: the case studies of the Amalfi Coast and the Cilento National Park IT sites

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The paper describes an innovative methodology for the governance and risk management of areas characterised by a high natural, cultural and landscape value. The proposed methodology is considered in a significant way from the natural, landscape, historical, artistic and cultural aspects: the Amalfi coast and the Cilento National Park, both registered in the World Heritage List. The paper, according with the strategies for the Reinforcement of the UNESCO's action for the Protection of Culture and the Promotion of Cultural Pluralism in case of disasters, it looks at the role of culture - in its broader definition - in strengthening resilience and fostering social cohesion for a more sustainable recovery, aligned with the Sendai Framework for Disaster Risk Reduction (SFDRR). The starting point for any management activity is the knowledge of the territories, understood as a descriptive element of the tangible and intangible aspects, which mutually act as support for the preservation of a single good. The complexity of analysing the territory with a trans-disciplinary approach, finds in the available informatics tools (GIS) valid support, thanks to which it has been possible to obtain a complex multidisciplinary and multilevel reading. The knowledge of the territory is completed, therefore, with the recognition and evaluation of the hazards, natural and human-induced, including also the socio-economic aspects which can cause hazards and therefore cause damage to the territory and the exposed goods, and/or be affected by the consequences caused by them. The multilevel reading of this information allows the identification of the socio-economic main issues of the territory and declines them according to the objectives described by the 17 SGDs (Sustainable Development Goals) that make up the 2030 Agenda and refer to different areas of social, economic and environmental development, which must be considered in an integrated manner, as well as to the processes that can accompany and sustain them in a sustainable way, including international cooperation and the political and institutional context in order to mitigate the risks with respect to the specific objectives that a territory places. In this way, it is possible to analyse the territories highlighting the positive and the critical aspects to define a Risk Governance program. This information is necessary to implement a participatory risk management program, considering the different priorities of the local communities and the various stakeholders present on the territories such as university centres, institutional and governmental bodies, using an appraised approach regarding the studied issues and in the context of the development of the circular economy policy. The paper shows some of the results of the obtained research on the territories of the Amalfi coast and Cilento National Park highlighting the importance of representing the cognitive information in a matrix form, comparing the criticalities found and the principles underlying the SDGs in order to reach the definition of essential guidelines for the management and governance of the territories.

Keywords: Amalfi Coast; Cilento National Park; cultural heritage; risk management; transdisciplinary approach.

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## Multiple flood experiences and perceived flood consequences: insights from the 2002-2013 floods in Germany

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Facing severe and repetitive floods, many European countries are changing their flood management approach from hazard to risk-based management, with the aim of preventing and mitigating harm. This approach has increased the role of households and their responsibility and self-efficacy in terms of reducing flood risk. This study is conducted with the aim of better understanding how the experience of multiple flood events leads to the implementation of private mitigation measures. Furthermore, the study tried to find out how the experience of multiple flood events and the average perceived the severity of the consequences of all the floods experienced interacts with respondents' sense of responsibility and response-efficacy in flood risk management. For this purpose, this study is conducted based on the questionnaire surveys distributed among 1,378 households in two states of Saxony and Bavaria, Germany. Two factors of multiple floods experienced and perception of the citizens about the severity of the flood consequences were considered to know how they affect the citizens' feel of responsibility and response efficacy to take personal action in future. The result showed that the percentage of households that have taken actions after the flood events is higher among people who experienced the multiple flood events than among those who did not. However, in the long term the rate of taking action among those with previous flood experience declines in flood risk managements. In addition, the effect of perceived consequences in feel of people towards responsibility showed for those who took action before the last flood, the high-perceived consequences would lead to greater denial responsibility. In addition, the effect of multiple flood experience in feel of people towards response efficacy showed for those who took action, people with the higher perceived consequences have more feel of response efficacy than those with the same perception but fewer experiences of flood. These findings can contribute to better understand the role of citizens in flood risk management, namely in terms of how and to what extent households should be motivated to take personal mitigation action.

Keywords: flood risk management; responsibility; self-efficacy; flood experience; mitigation action.

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## Towards the integration of Disaster Risk Reduction and Climate Change Adaptation: good practices in the UK to develop a platform for stakeholder communication and engagement

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Both, Climate change adaptation (CCA) and Disaster Risk Reduction (DRR) focus on reducing vulnerability and share many similarities. Therefore, a number of researchers, policy makers, and practitioners have suggested integrating CCA and DRR. Though, there are many discussions on integrating CCA and DRR, less is happening on the ground as there are many challenges to integrate CCA and DRR. Some of these challenges are inadequate stakeholder platforms for CCA and DRR, horizontal and vertical coordination issues in CCA and DRR governance, resource limitation and poor implementation strategies, lack of funding and political motivation. The effective integration of CCA with DRR requires the participation of a wide range of stakeholders: policy makers, private companies, scientists, NGOs, and educators. Multi-stakeholder and multi-sectoral processes are vital in building common understanding, commitment and consensus. Within this context, communication between CCA and DRR stakeholders become an important issue for sustainable, long-term integration of DRR and CCA. However, there are several issues surrounding CCA/DRR stakeholder communication to be overcome in order to effectively integrate CCA and DRR. For example, CCA terminology tends to be more technical or scientific, which cannot, or is more difficult to, translate into simpler language. As a result, it is difficult to communicate at the community level where DRR actions take place. Also, in many contexts, there is no clear notion of whose responsibility it is to coordinate CCA and DRR stakeholders. Generally, as a result of these issues, platforms for effective communication between CCA and DRR stakeholders are not opened. Therefore, it is extremely important to find out solutions to bridge this gap, in order to effectively integrate CCA and DRR. Accordingly, based on findings of a national review on the UK, conducted by a project entitled ESPREsSO funded by the EU horizon 2020 programme, this paper reviews the good practices in the UK to develop a platform for stakeholder communication and engagement towards the integration of CCA and DRR. This study is mainly based on a narrative literature review, in addition, semi structured interviews were conducted with the respective experts who have implemented good practices on stakeholder engagement in the UK towards the integration of CCA and DRR.

**Keywords:** climate change adaptation; disaster risk reduction; integration; stakeholder engagement; good practices.

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## Mapping the path to more resilient food supply chains: a novel approach to bespoke vulnerability identification

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It is increasingly accepted that supply chains in all forms face increasing volatility across a range of business parameters from energy cost, to competition for raw materials. Food Supply Chains not only share these general risks, but also face their own unique vulnerabilities due to the limited shelf life of food and the myriad factors that can influence the quality and quantity of agricultural yields. Clearly there is a need for food supply chains to become more resilient, something which goes beyond merely the ability to resist disruptions and includes the ability to detect and adapt to changing operating environments. This requires the accurate identification of specific vulnerabilities that make a given actor in a supply chain (i.e. a company) susceptible to disruption. Only then can mitigating capabilities be assigned in a way that is both adequate to deal with the threat faced and proportional in terms of any negative side effects associated with the resilience capability chosen. However, traditional risk management approaches typically rely upon historical likelihoods of occurrence and consequences of impact rather than real time mapping. This presents a challenge in contemporary volatile food supply chains where vulnerabilities are less likely to have been encountered previously. In response, the aim of this paper is to present a novel, real-time mapping procedure that different actors within a food supply chain can use to identify their bespoke vulnerabilities. This aim is facilitated by three objectives: i) To identify the indicators that a company would use in a mapping process to evaluate their supply chain; ii) To identify under what circumstances the aforementioned indicators would suggest risk of a failure mode and to categorize what these failure modes are; iii) To identify what causal underlying vulnerabilities may lead to each failure mode. This research is abductive in nature. It is based on a thorough review of the existing, multi-disciplinary literature and utilizes empirical validation in the form of two case studies in the UK chilled convenience food sector to validate and develop the mapping procedure. Empirical validation has demonstrated the ability of the mapping process to identify high priority exposure points for two companies which are comparable in terms of sector but which have very different supply chains. Both companies indicated a reliance on road networks and single suppliers as high priority exposure points. However, validation also revealed that even though on paper two companies might identify similar vulnerabilities, company specific factors such as available resources and even attitudes can determine whether exposure manifests as an actual disruption. This framework offers a method by which different actors can supplement their traditional risk management opportunities by investigating the real time state of their supply chain and allocating responses proportionately. This encourages a shift in stance away from simply trying to resist and outlast disruptive events, towards a more adaptive approach which is important in increasingly volatile food supply chains. A limitation is the small number of case studies and further empirical validation would be useful to test the applicability of the procedure in different food supply network contexts.

Keywords: food supply chain resilience; food security; supply chain management.

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## Critical institutional capacities to strengthen downstream multi-hazard early-warning risk communication in rapid onset hydro-meteorological and geophysical hazards: the case of the Philippines

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A country's institutional architecture significantly influences disaster risk governance. The potential effectiveness of institutions towards mitigating disaster impacts can be evaluated by examining two dimensions of its capacity: (1) the legal and policy environment, and (2) the coordinating mechanism. This study considers these factors by investigating the case of the Philippines, one of the most disaster-prone countries in the world. Specifically, the study analyses institutional capacities in the context of the Philippines' downstream multi-hazard early-warning system (MHEWS) for rapid onset hydro-meteorological and geophysical hazards. The risk communication pathway of the Philippines' MHEWS is designed to match the country's decentralized and devolved governance system as risk communication not only entails transmission and feedback of information, but also ultimately compels action and response from authorities to reduce the risk. A combination of literature review on early warning systems and good country practices, document analysis of government publications, and retrospective analysis using authors' professional engagements in the disaster risk reduction and management (DRRM) sector of the country were conducted. The study found that the MHEWS of the Philippines is a complex system of systems tied to a devolved style of governance. The country's DRRM legal & policy environment is mature and evolving. There is strong political recognition of the benefits of an MHEWS, manifested in the abundance of policies, frameworks, and plans produced by its DRRM institution in all levels of governance. The completion of the National Disaster Prevention & Mitigation Plan which should elaborate the guidelines for the national and localized MHEWS, among others, should be prioritized. There should be a systematic assessment of the quality of the localized DRRM plans and local governments should seize the opportunity to purchase materials and conduct exercises for disaster preparedness. On the other hand, the country's elaborate hierarchical coordination mechanism is not entirely efficient, but workable. Expansion of the communication pathway to trigger local response greatly improved the system without reinventing the structure. Meanwhile, it was found that the risk communication tools and practices within the coordination mechanism are critical such that there should be more attention on how risk information is processed, translated, and delivered downstream. Enabling local governments and their DRRM offices to collaborate with academic and research institutions in their localities will facilitate the study of effective risk communication methods tailored to their local conditions and cultures. To address the physical requirements for communication and information exchange, government should invest in sound and durable technologies ensure that communications protocols reach the far and isolated households, and that a feedback mechanism is activated. Over time, the DRRM institutions will likely need to restructure to the changing needs of such MHEWS; therefore, the goal should not be a perfect MHEWS but one that is adaptive and continuously seek to strengthen its capacities.

Keywords: early warning systems; disaster risk governance; disaster risk communication.

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## Gaps in evacuation planning for the coastal communities; case study in the Philippines: BASECO compound

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The recently concluded International Workshop on multi-hazard early warning and resilience building in coastal communities which was conducted in Kandy, Sri Lanka in March 2018, as part of the Erasmus+ Capacity Building for Higher Education grant, CAPacity Building in Asia for Resilience EducaTion (CABARET) highlighted the need to look at the gaps in evacuation planning for coastal communities. This study is a result of the sandpit organized during the workshop which aims to look into this need through the framework of international collaboration among Higher Education Institutions (HEIs) from Myanmar, Sri Lanka and the Philippines in order to compare strengths and weaknesses in evacuation planning across the three countries and which hopefully will result in new insights that will strengthen the various components of evacuation planning. The total length of the coastline of the Philippine archipelago is 36,269 km, which is one of the longest in the world. These areas are susceptible to multiple hazards which include, but not limited to, hydrometeorological and geophysical hazards such as: flooding, storm surge, coastal erosion, tsunami, ground shaking, lateral spread and liquefaction. Unfortunately, majority of coastal communities are composed of fisher folks and informal settlers which are among the most vulnerable sectors in society to the impacts of these hazards. The study site for chosen for this study is the BASECO Compound, an urban coastal community at the port area of Manila with an elevation of approximately 2 meters above sea level on reclaimed land using garbage and other materials. It is a densely populated community with a population of 60,000 in 2015 in a land area of just 53 hectares. The questionnaire developed during the sandpit session was used in order to assess the evacuation planning in BASECO and compare it with case studies from Myanmar and Sri Lanka. The questionnaire aims to determine the existing coastal hazards, identify vulnerable groups, assess the community's capacity and preparedness, as well as draw insights and suggestions for an effective and site specific evacuation planning from the community. The three counties share common vulnerability conditions which covers physical, social, economic and environmental factors increasing the susceptibility of coastal communities to the impacts of coastal hazards. This includes poverty, old age, poor health, lack of education and access to basic services, and coastal communities being composed mostly of informal settlers among other things. This emphasizes and validates the importance of a collaborative approach of this study which is line with the global targets of the Sendai Framework for Disaster Risk Reduction namely to enhance international cooperation to developing countries through adequate and sustainable support and increase the availability of and access to multi-hazard early warning systems and disaster risk information and assessments to the people.

Keywords: coastal communities; coastal hazards; evacuation planning; early warning systems; international cooperation.

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## Effectiveness of early warning and community cooperation for evacuation preparedness for mega-risk type coastal hazard in childcare centers

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Childcare centers are institutions that take care of children aged 0-5 years, who have reduced capability on autonomous walking and require assistance in case of disasters. Therefore, it is even more difficult to ensure their safety in case of multi-hazard disasters that require urban-scale evacuation, such as earthquake and tsunami. During the 2011 Great East Japan Earthquake (GEJE), 722 childcare centers were affected by earthquake, of which 78 facilities severely damaged by tsunami in the prefectures of Fukushima, Miyagi, and Iwate. Despite the devastating damage, there were only three casualties of infants under the care of nursery, indicating that counter-disaster measures contributed to avoiding further fatalities. This paper aims to investigate factors that contribute to strengthening the resilience of childcare centers from mega-risk type coastal hazards, focusing on the effectiveness of early warning and community cooperation that were observed in areas affected by GEJE. As method, field survey and interviews to former teachers of facilities inundated by tsunami were conducted from November 2012 to September 2016 in Kesennuma and Kamaishi (municipalities located respectively 130 km and 220 km from Sendai), with the purpose of analysing the following topics: situation before GEJE (overview of facility, disaster prevention plan and evacuation drills), during GEJE (damages, early warning, cooperation of local community for evacuating nursery infants, sheltering and rescue), and after GEJE (efforts to strengthen the resilience of facility). The main results are as follows: facilities located near seaside tends to be more concerned about the risk of tsunami and started evacuation to higher places even before the announcement of tsunami warning; the tsunami warning was verified through municipal disaster prevention radio system and nationwide warning system for mobile phones; the destination of evacuation was changed several times, to areas even higher than the designated inundation hazardous areas, due to the increase of the risk for higher tsunami and secondary hazards, such as tsunami fires; facilities that had preventively designated the emergency meeting place with parents in elevated sheltering places could start evacuation immediately after earthquake, while facilities that had designated the emergency meeting place with parents within the facility had a delayed evacuation; facilities that started early evacuation could get more cooperation from the local community (residents, employers of companies located in the vicinity, teachers and students of elementary schools, etc.) for evacuating nursery children in urban environment, transporting them by piggyback ride or using multi-passenger buggy stroller in steep slope; facilities that had delayed evacuation had relatively greater difficulties in getting cooperation from the community, as well as difficulties to move forward due to traffic jam. As conclusion, in the subsequent evaluation of disaster preparedness for future emergencies after GEJE, childcare centers located in the seaside tend to designate the destination of evacuation in even higher places, outside tsunami hazardous area, to avoid risk of secondary disasters, such as tsunami fire; planning the evacuation procedure according to the severity of multi-hazard early warning, under the knowledge of the children's parents; and ensure in advance the regional cooperation and partnership for evacuation preparedness.

Keywords: tsunami; multi-hazard risk; community partnership; vulnerable group; evacuation preparedness.

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## Role of HEIs in achieving regional cooperation for effective multi-hazard early warnings in Asia

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Asia reported the highest number of affected people by coastal hazards during the last two decades. Coastal hazards are significantly increased with rapid change of climatic conditions across the globe. The issues are further complicated with the rise of population live in coastal areas as well as with development activities take place in coastal regions. In order to control and minimize these devastating results of coastal hazards, leading international frameworks, practitioners and academics have introduced innovative strategies to reduce disaster risks and enhance resilience. Among these strategies, multi-hazard early warnings have been identified as an effective way of dealing with different types of coastal hazards. However, the level of development of multi-hazard early warnings in Asia shows uneven progress across member countries in Asia. Hence, member countries in the region call for a regional cooperation to share knowledge and resources towards achieving effective multi-hazard early warnings in the region. However, there are many capacity gaps that the effectiveness of regional cooperation. In this context, higher education institutions are identified as important agents who can develop capacities among member countries towards effective regional cooperation. This paper is based on the initial stage of a project funded by the European Commission Erasmus Plus to enhance capacities among higher-education institutions in Asia towards effective multi-hazard early warnings in Asia. The study has been carried out among 15 member countries in Asia and Europe with key stakeholders. In order to identify the present level of regional cooperation towards multi-hazard early warnings and the role of higher education institutions in Asia, the study conducted a regional survey using a survey questionnaire. The results revealed that there is a regional cooperation between member countries towards effective MHEWs in Asia though it suffers with many issues. The survey further revealed that there are needs to improve capacity development, training methods and innovations in multi-hazard early warnings in the region. The role of higher education in Asia does not deliver to its expected level. This is because of limitations in funding availability, lack of coordination with other institutions/ stakeholders, gaps in knowledge, lack of supportive policies and political support, lack of self-interest and awareness, lack of information and communication barriers. These findings will help the policy makers to identify the gaps in HEIs to enhance their role in developing regional cooperation towards effective multi-hazard early warnings in Asia. Accordingly, the project will fulfil this utmost important need in developing multi-hazard early warnings in Asia through conducting trainings among members of higher education institutions and other key stakeholders in Asia.

Keywords: capacity building; Asia; regional cooperation; multi-hazard early warnings; higher education institutions.

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## Community-based multi-hazard early-warning system in disaster prone rural areas of Pakistan

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The disaster impacts increase when there is no proper multi-hazard early warning system to support disaster management mechanism for communities as immediate responder. During last few years, the communities living in rural areas of Pakistan have been experiencing serious challenges due to ineffective multi-hazard early warning system. The communities living in remotely located rural areas of the country lack access to real-time risk information and knowledge about using modern technological equipment therefore they experience high level losses in lives and livelihood. The disaster risk reduction measures are often undermined since multi-hazard early warning measures designed for communities do not consider importance of disaster education, access to disaster risk information, analysis of disaster forecasts and national coordination mechanism for hazard communication and also communities' lacking response to hazard alerts. The threat assessment is central in disaster management process since, the message of upcoming hazard may reach the communities however it essentially depends on how they react and realize about the scale of hazard they are going to face. In previous disaster cases of Pakistan, people received emergency alerts but were ignorant about the level of hazard severity therefore it became very difficult to avoid higher losses when disaster affects were very near and communities were unprepared. The research is based on both qualitative and quantitative methods whereas, the primary and secondary resources related to community-based multi-hazard early warning system including field visits, interpersonal discussions, expert views and community experiences along with national policies are used to analyze the whole process. The community based multi-hazard early warning practices in disaster prone rural areas primarily rely on hazard advisories disseminated through mosque loudspeaker to inform people about evacuation places and counter-measures to save lives and their belongings in case of any flood or earthquake. In some cases, people gather around community notables to learn about the disaster hazards and workout for possible countermeasures to avoid such losses. In rural areas, the notables are usually community elder or religious scholars who with their limited knowledge and information sensitize people about disaster hazards. The non-governmental organizations have been extending their support for communities with their limited capacities however, the need for benefitting out of modern sources of disaster forecast and information requires significant expertise whereas such limitations seriously hamper multi-hazard early warning and disaster management efforts for the community. Moreover, the lacking disaster education and awareness about the management of its consequences along with inherent flaws in community based multi-hazard early warning practices further increase the risk of loss during disasters. The obsolete methods without modern technological equipment become a reason of excessive destruction. The inadequate disaster legislation for access to risk information, capacity building of communities and role of government officials at local levels for proper coordination and mutual support are most prominent reasons that result in highly difficult situation to manage disasters at community levels.

Keywords: community-based early warning; disaster vulnerability; risk information.

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## Flood flow rates in the Mondego River in the region of Coimbra: a complex problem for risk management

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The floods of the Mondego River in Coimbra are part of its hydrological history. The semi-torrential nature of the Mondego's regime and the contribution of tributaries, such as the Ceira River, determine the magnitude of the floods, with negative social, economic and environmental impacts. Currently, flood control and flood protection are based on the system comprising the dams of Aguieira, Raiva and Açude-ponte on the Mondego River, and the Fronhas Dam on the Alva River, most of which came into operation in the 1980s. Downstream of Coimbra, in the Lower Mondego segment, the defence system consists of two peripheral beds, marginal dikes, including three siphon dikes, and a fuse dam. The Açude-ponte Dam has a discharger with a maximum flow capacity of 1,200 m<sup>3</sup>/s, for T-100, and 2,000 m<sup>3</sup>/s, for T-1,000. The recent history of the floods in Coimbra has shown that the Lower Mondego flood-control system has not been efficient. On January 26<sup>th</sup> and 27<sup>th</sup>, 2001, the level of the free surface in the regularized riverbed on several sections reached the crest of the levees and broke them. On February 13<sup>th</sup>, 2016, the water level approached the crest of the dikes, having required the opening of the dike near the Choupal National Forest. An integrated evaluation of the flow rates (considering the instantaneous maximum flows) in the Açude-ponte Dam since 1981 reveals several occasions in which the 1,200 m<sup>3</sup>/s threshold was superseded. In each event, the tributaries and effluents of the system composed of the Aguieira, Raiva, Fronhas and Açude-ponte dams, and the tributaries of the Cabouco Bridge and the Conraria Bridge system, both on the Ceira River, were analysed, and the values of the flow of the Mondego in the intermediate basin, between the mouths of the Alva River and the Ceira River, were also determined. During the January 2001 floods, the maximum instantaneous inflow at the Açude-ponte Dam was 1,990 m<sup>3</sup>/s, with the Ceira River making a significant contribution to the magnitude of the floods in Coimbra, with a flow rate of 660 m<sup>3</sup>/s. In the flood event of January 11<sup>th</sup>, 2016, the tributary flow to the Açude-ponte was 1,498 m<sup>3</sup>/s, while the one of the intermediate basin and the Ceira River was 336 m<sup>3</sup>/s. In the February 2016 flood, the effluent flow of the dam system composed by Aguieira, Raiva and Fronhas corresponded to 1,060.5 m<sup>3</sup>/s; the measured flow of 1,960.5 m<sup>3</sup>/s at the Açude-ponte indicates that the contribution of the Ceira River to this total flow was 900 m<sup>3</sup>/s. One can thus conclude that the expected flow rates calculated for the Açude-ponte were underestimated. Indeed, the Ceira River and the intermediate basin make a considerable contribution to the magnitude of the floods that occur in Coimbra. Therefore, for a better assessment of the actual flood risk and for a proper management before and during the events, flow logging cannot be summarized at fixed points (e.g. the dams of Aguieira, Raiva, Fronhas and Açude-ponte). A crucial requirement is to know the flows within the river basin in a comprehensive manner, which can be attained through the expansion of the Water Resources Monitoring and Alert System.

Keywords: Mondego River; tributaries; food flows; risk management.

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## Oil-spill environmental hazard and community adaptive livelihood alternatives: the Nigeria case

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It is important to establish that when the issues of oil spill responses are mentioned, the national oil spill detection and response agency comes to mind. This is due to the fact that the National Oil spill detection and response agency is an institutional framework that is established to coordinate implementation of the National oil spill contingency plan (NOSCP) with the mandate to embark on joint investigation visit, ensures remediation of impacted oil spill sites and monitors oil spill drill exercises and facilities inspections. The agency which is with the vision to create, nurture and sustains a zero tolerance for oil spill incident in the Nigerian environment is with no doubt the most relevant agency in the context of oil spills remediation, investigations and compensation intervention intermediary. Even though, other (oil spill) disaster management related agency exists within the Nigerian context. The fact that NOSDRA is directly mandated with vital roles in regards to oil spills deem necessary to visit and re-visit their intervention strategies between the communities, and the oil and gas sectors whose activities and or facilities have contributed eminently to environmental devastations and livelihood disruptions of vulnerable communities. Importantly, since the Agency liaises with different stakeholders in the oil and gas industry to evolve practical methods of environmental management to cope with the dynamics of the petroleum sector. That also emphasises the power bestowed to the agency and thereby create the importance to evaluate their responsibility in regards to the interventions between communities and the oil and gas industry. This study aims to identify the interventions strategies by the agency in regards to intermediary actions between the community and the oil and gas industry in relations to oil spills incidents, compensations, remediation's and clean-up process. The subsidiary objectives of this paper were to evaluate the barriers/ challenges hindering intervention process and measures that could be applied for reductions as a means to improve intervention process and strategy. Data were gathered from key representatives from the oil spill related agency to answer the question; what are the most and effective intervention strategies employed by the agency in regards to oil spill affected communities and the oil and gas industry, and how are the measures improved the intervention process? The paper gives recommendations on how the strategies could be improve to reduce community vulnerability to oil spill hazards.

Keywords: oil spill hazard; oil spill agency; intervention; Niger Delta; Nigeria.

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## The downstream mechanism of the end-to-end tsunami warning and mitigation system in Sri Lanka

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An end-to-end tsunami early warning and mitigation system (TEWMS) is a risk reduction mechanism widely used to predict the risk of a tsunami inundation and thereby warn the people to evacuate to a safer area. This process typically involves an upstream involving detection of earthquake and prediction of a tsunami, and a downstream in which the warning is disseminated to public for evacuation. Between these two, there occurs an interface where the impact of tsunami inundation is analysed in each country, the warning decision is taken and issued to the public. In case of Sri Lanka, the warning and evacuation decision is taken centrally by the government. However, after the warning is issued by the national disaster management centre, the order for evacuation is disseminated to the public through several channels using different techniques. This process involves a number of stakeholders, uses technical and human resources, and influenced by various social, cultural and political factors. This presentation is an analysis of the downstream process of tsunami early warning system in Sri Lanka, with particular focus on decision making and warning dissemination below the national level. Using a literature based conceptual framework, data was collected through key informant interviews, focus-group discussions and observations. In the findings, a number of gaps in the downstream process that affects the effective information delivery and safety of the public are highlighted, and the authors provide recommendations to overcome the shortcomings.

Keywords: tsunami; early warning system; interface; downstream; Sri Lanka.

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## Interactions between single-hazard early-warning systems and multi-hazard maps: the case of the Everest region in Nepal

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In mountain regions, villages might be threatened by quite different natural hazards like e.g. floods, debris flows, rock falls, snow avalanches and glacial lake outburst floods (GLOF). Rescue ways and areas are significantly varying depending on the specific type of natural hazard. In the case of a popular tourist destination – the Everest region in Nepal – the potential GLOF of the Imja lake poses severe risks to numerous villages downstream of Imja and Dudh Koshi rivers. While early warning systems and multi-hazard maps have been widely analysed in literature, most research has not adequately addressed the potential critical interactions between single-hazard early warning systems and multi-hazard maps. The main purpose of this study is to explore these potential interactions as well as communication issues due to missing community involvement in the development of early warning systems and multi-hazard maps. Applied methods include literature study, field observation and a qualitative survey in 2018. In the case of the Everest region, a combination of single and multi-hazard approaches was used to set up a GLOF early warning system. The GLOF early warning system is a single hazard early warning system, whereas the corresponding hazard maps used to inform the public are multi-hazard maps. These maps show the potential GLOF inundation depth but just along the river course, offside of the main river geomorphic hazards such as e.g. debris flow, rock fall or earth and debris slide hazards are presented and classified as low, medium and high. However, no information is provided, which process led to the presented and classified geomorphic hazard. Being entitled “GLOF risk management” these maps are not only confusing experts but also tourists and community members if being perceived at all. While the location of GLOF evacuation centres are presented in the multi-hazard maps, most confusingly some are located in geomorphic high hazard areas. First results of the case study emphasise the importance of risk communication and community participation. A potential dangerous confusion concerning hazard areas is caused by the unfortunate combination of a single hazard early warning system with multi-hazard maps. When setting up single early warning systems it is valuable also to think about multi-hazards, since alarm sirens and evacuation centres should not be located in areas of high geomorphic hazards. In the most threatened village the multi-hazard perspective was not carefully considered and the alarm siren placed in an area of high rock fall hazard. By closely examining the interlinkages between the GLOF early warning system and the multi-hazard maps in the case of the Everest region, Nepal, the study underlines the significant role of a holistic community-based risk management and communication. Potential development pathways for improvement of early warning system will be shown.

Keywords: community-based; early-warning system; multi-hazard maps; glacial lake outburst floods; Nepal.

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## A study of DRR and CCA integration in Semarang City, Makasar City, and Sidoarjo District, Indonesia

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Indonesia has both the fastest urbanisation growth rate and the largest share of urban population globally, rising to 67% by 2025. Urban agglomerations also emit significant and growing amounts of greenhouse gases and Short-lived Climate Pollutants, that contribute to global warming, but also impact public health, food, water. Coastal urban agglomerations are especially exposed to the impacts of climate change and disaster risks. In the coming decades, climate- induced extreme events are expected to increase. These changes will continue to affect natural and human systems independently or in combination with other determinants to alter the productivity, diversity and functions of many ecosystems and livelihoods. Climate change impacts and variability threaten to exacerbate existing vulnerabilities and further entrench development disparities. There is increasing recognition that disaster risk reduction should include climate change adaptation. These two perspectives have been developed by different communities, but the aim of both is to reduce vulnerability and hazard exposure in order to increase resilience to the potential adverse impacts of climate extremes. The integration of the two fields provides opportunities to strengthen the common parts and improve the management of present and future hazards and risks. Despite such potential benefits there remains some significant challenges. They remain distinct fields and collaboration has proven difficult. There are separate communities of working in the two areas, with limited overlap in networks, fora and methods. This is an account of a comparative study into methodologies and tools used to enhance the integration of DRR and CCA in development processes in the coastal cities of Semarang City, Makasar City, and Sidoarjo District in Indonesia. The study considers four key elements that underpin DRR and CCA: Legal Frameworks; Budgeting; Institutional Frameworks; and, Implementation Frameworks.

Keywords: convergence; coastal resilience; Indonesia.

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## Livelihoods of the last mile: a case study of how rural households in development contexts manage evolving disaster risk and the challenges for early warning of rural-urban migration

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The means of improving disaster early warning have largely been considered through the greater incorporation of information at all timescales and of multiple hazard typologies. This carries with it its own challenges, not least the significant forecast uncertainty over longer lead times, and the ability to incorporate risk knowledge from, and disseminate warning to, the local level – the ‘last mile’. The challenge is acute in rural development contexts, where the persistent limitations of Disaster Risk Reduction (DRR) governance mean that livelihoods have been the principal means by which households have pursued self-reliance and attempted to maintain resilience. Under such drivers as climate change, local populations are predicted to be both increasingly susceptible and increasingly mobile in response to evolving disaster risk, but rural livelihoods are complex and location specific, and incorporate diverse farm and non-farm resources that pose challenges to operational assessment. The research applied a livelihood systems framework adapted from the Disaster Resilience of Place (DROP) conceptual model to structure enquiry into this complex dynamic. Specifically, a baseline to define a boundary and the key antecedent components of exposure, vulnerability, and organisation; disaster dynamics as represented by hazards, warning, and short-term responses; and household capacities as demonstrated by longer-term adjustment to livelihood portfolios. This enquiry was implemented by an ethnographic, iterative methodology using established Community Risk Assessment (CRA) indicators from DRR praxis to build a case study of three villages in Lao PDR, situated approximately halfway between the Thai and Vietnam borders. The results of the study revealed that in the preceding two to five years alone, cross-border trade, land encroachment, foreign-direct investment, mechanisation, and off-farm migration had resulted in higher incomes for some, but in many instances had combined with new disaster dynamics to place greater stress on the local livelihood system. Respondents themselves believed that a threshold may have been reached whereby in the event of a range of potential crises, in situ capacity and traditional DRR strategies may no longer be viable and that the best option may lie in outmigration. The livelihood system was in a state of flux; this state was reached through a complex feedback mechanism within and between livelihood categories, within and across national borders, and carried with it the potential for emergence or future systemic collapse that may lead to large-scale displacement. This has at least two implications for DRR programming. First, it questions, but does not necessarily invalidate, established programming based on incremental adaptation in situ. Second, it underscores the importance of further research aimed at improving the predictive capacity of multi-hazard early warning systems. Combined, both approaches remain the best means of no-regrets DRR, but may not be enough to hedge against future disaster risk that is stochastic, potentially emergent, and increasingly transboundary in both cause and effect. Framing the last mile through livelihood system enquiry may offer a way forward, but the means of structuring assessment and warning of evolving disaster risk in such complex and dynamic systems, remain an unresolved operational challenge for DRR praxis.

Keywords: early warning; livelihoods; migration; systems thinking; disaster risk reduction.

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## Micro-scale study of Climate Change Adaptation and Disaster Risk Reduction for coastal urban strategic planning in Jakarta Metropolitan Area

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Sustainable economic growth and development are two main important factors for urban agglomerations (metropolitan region) planning. However, several coastal metropolitan regions in Indonesia are exposed to the impacts of climate change and disaster risks. Especially Jakarta Metropolitan coastal region has been exposed to the rapid increase of urban center disaster, a complex, dynamic and critical issue induced by climate change impact and man-made disaster. Fastest urbanization and industry growth in the North of Jakarta has led to the high use of ground water causing severe land subsidence, coupled with climate change impact, increased inundation has been found in the North Jakarta coastal. There is also significant recognition that disaster risk reduction (DRR) should include climate change adaptation (CCA), in order to increase resilience to the potential adverse impacts of climate extremes. This paper aims to present result of the in-depth study on the assessment and development of strategic disaster risk reduction plan which integrate the climate change adaptation countermeasures at one of North Jakarta City sub-districts, i.e. Cilincing sub-districts. This sub-district is a composite model of households, business, manufacture industries and port. The study has covered not only hazard assessment induced by increased susceptibility but also vulnerability as base line study as well projected up to 2045 (the golden century for Indonesia) at the micro level, with sub-sub-districts level as unit analysis. Meanwhile the capacity analysis is used as the baseline data, which is reviewed against the trend of the hazard and vulnerability. Findings at micro level are very important to present more holistic and realistic implementable strategy until 2045, then followed by up scaling into Metropolitan region planning.

Keywords: convergence; hazard; vulnerability.

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## A study of the upstream-downstream interface in end-to-end tsunami early-warning and mitigation systems in Indonesia

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After the Indian Ocean Tsunami in 2004, tsunami preparedness has become a significant aspect in the research and practice of disaster resilience. Also in Indonesia, since this tsunami disaster, Indonesia began to build Ina-TEWS or Indonesia Tsunami Early Warning System. The upstream is the process of observation, monitoring, detection, analysis and dissemination of early warning. While the downstream translate early warning into the evacuation command following the dissemination of evacuation orders. Between these upstream and downstream phase, there is interface where the received warning information is conveyed through the formal authorities and decision to evacuate is taken. Interface mechanism is very complexity because involving various stakeholders / stakeholders from national to local level, diversity of channels / modes for the dissemination of tsunami early warning, complexity of communication patterns of tsunami early warning and will depend on the social, economic, political and cultural context. Considering those complexities, this is an account of a study into the tsunami early warning interface of Ina TEWS with the aim to understand the technical, legal and socio-cultural complexities that occur at the interface mechanisms of the tsunami early warning system in Indonesia. The methodology of the study will involve several processes such as desk study, primary data collection, focus group discussion and analysis. The results highlight a number of problems and gaps in interface mechanism/institution of Ina-TEWS. These include roles and responsibilities, standard operating procedures, human resources, legal frameworks, dissemination equipment and social media.

Keywords: tsunami early warning; Indonesia; upstream-downstream interface.

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## TRACK 2B

Risk governance: lessons from the past and future trends

José Manuel Mendes | University of Coimbra, Portugal

## **The National Plan for Disaster Management of Bangladesh: process, product and promulgation**

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The National Plan for Disaster Management (NPDM 2016-2020) of Bangladesh was prepared by the author for the Ministry of Disaster Management and Relief (MoDMR), supported by the United Nations Development Programme (UNDP), and it is aligned with international frameworks including the Sendai Framework for Disaster Risk Reduction (SFDRR). The plan aims to operationalise disaster risk reduction through identifying priority actions, providing a roadmap for implementation of core investments, incorporating resilience in sectoral plans, exploring public-private investments, ensuring inclusivity, addressing emerging risks, promoting risk governance and illustrating how different stakeholders can contribute. The development process was inclusive, involving extensive consultations. While the planning process and the product itself were significantly rigorous, its promulgation in terms of translating into implementation, institutional capacity building and uptake at different levels remains uncertain. Resourcing, both financial and human, is a key challenge, compounded by other contextual factors. On the other hand, Bangladesh has made significant socio-economic gains, with investments in DRR decreasing disaster mortality. Thus, given such achievements, and the political will to engage in developing a comprehensive plan, it can be expected that many of the targets of NPDM 2016-2020 might be addressed over the long term.

**Keywords:** Bangladesh; disaster management; National DM Plan; Sendai Framework.

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## Harmonizing policies to enhance the cross-border regional resilience of the Guangdong – Hong Kong – Macau Greater Bay Area

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Improving infrastructure, community and urban resilience has now become the main focus of many metropolis and regions to pursue sustainable development and tackle multi-hazards including natural disasters, climate change, man-made shocks, and infrastructure and environmental challenges. The international society has recently made a concerted effort by setting the post-2015 development agenda to achieve the goal. Being a crucial part of China's on-going regional development strategy, building a liveable world-class city cluster in the Guangdong-Hong Kong-Macau Greater Bay Area necessitates underpinning the regional resilience. However, it is a great challenge to make and implement synergized policies to improve the cross-border regional resilience due to the heterogeneity of the governance and legal systems of the three places. The aim of this paper is to provide a theoretical analysis for the policy makers in the Greater Bay Area to formulate a harmonized blueprint for resilient city cluster planning and development. First, an enhanced version of the framework for adaptation and resilience policy analysis (FARP) developed by the author is presented. After the top eight common hazards facing the member cities of the Greater Bay Area are determined through two rounds of interview with different policy-making stakeholders, policy instruments pertinent to regional resilience that are being / have been implemented by the Greater Bay Area member governments are sorted out, and then grouped into different matrices with community capitals and widely recognized "NATO" scheme (nodality, authority, treasure and organization) as the horizontal and vertical dimensions. Those matrixes are finally qualitatively analysed to appraise and align the policy making and execution processes and evaluate resilience policy performance. The preliminary findings of this research reveals that: 1) Hong Kong, Macao and Guangdong province have all recognized the importance of drawing up long-term roadmap for tackling global climate change and have devoted many efforts to mitigate natural disaster risks and environmental degradation; 2) there are a few cooperation initiatives in the Greater Bay Area to enhance regional resilience; 3) the heterogeneity of the governance structure within the bay area cities exerts a great challenge in aligning and orchestrating various resilience policies; 4) treating all community capitals as a whole, engaging citizens, and deploying balanced "N", "A", "T", "O" policy instruments would assist improving the regional resilience; and 5) the resilience policy matrixes and the FARP framework hold fascinating and promising potentials to make the analysis and comparisons of resilience policies simple and easy-to-understand. In a word, the cooperation between the three places for enhancing regional resilience is still at infancy stage; and the resilient Greater Bay Area can only be developed through concerted resilience policies, connected and integrated infrastructures, open and inclusive cross-border communities, and closed and harmonized intergovernmental cooperation.

Keywords: cross-border regional resilience; the Greater Bay Area; public policy; policy instrument; post-2015 development agenda.

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## Governance of urban social-ecological systems: a theoretical reflection for resilience through urban planning practices

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Today, more than ever, human and nature are closely coupled in complex and interconnected social-ecological systems (SES) referred as “cities”. The Anthropocene - the new geological era which we live in is characterised by climate change, environmental degradation, biodiversity loss and increasing risks. The Sendai Framework serves as a practical guideline to manage the changing dynamics of human-nature linkages in cities to stay resilient within planetary boundaries. As urban social-ecological systems evolve to host increasing numbers of inhabitants, the environmental externalities emerging from these systems are also becoming more complex and profound. Since urban planning plays a significant role in the way we govern the complexity of urban social-ecological systems, what can we learn from complex systems to improve urban planning for sustainability? This key question leads to a theoretical knowledge inquiry on Systems, social-ecological systems and the governance of such systems, from which the paper proposes ways forward for resilience thinking to improve urban planning practices for climate risk reduction and environmental sustainability. The paper has a three-fold objectives: 1) to describe the nature and structure of Systems and urban social-ecological systems; 2) to reflect on the theoretical perspectives of governance of urban social-ecological systems; and 3) to propose ways forward for resilience thinking to improve urban planning practices for climatic risk reduction and environmental sustainability, as for example cored in the Sendai Framework. Two main methods are applied: descriptive approach and deductive reasoning. The paper possesses a theoretical focus on systems complexity and governance of urban social-ecological systems through descriptive approach. Relevant theories and concepts include risk and resilience, complexity theories, adaptive cycle and Panarchy, actor-network theory (ANT), systems approach, sustainability and urban planning theories. Deductive reasoning is also applied to suggest explanations for the incompetence of current urban sustainability practices, and also to provide suggestions on adaptive governance for building resilience. The paper expects to find that 1) The nature and structure of social-ecological systems are intrinsically complex, interconnected and co-evolving. 2) Risks in the present environmental reality are increasing both in complexity and profundity, which indirectly translates into the degree of challenges in governance and resilience building. And 3) urban inhabitants are actors with triple functions in social-ecological systems who are not only impacted by environmental problems, but also are the producers of such problems themselves, and therefore can also take part in problem-solving processes. Conclusions: knowledge of the nature and structure of social-ecological systems are essential to inform urban governance for addressing environmental risks. Increasing risks in the present environmental reality prompt the urgent need to recognise the largely disciplinary and siloed characteristics of the current urban governance, as well as to adopt a more participatory, systemic and inclusive approach and thinking. Last but not least, the triple functions of urban inhabitants as actors in complex social-ecological systems is a key insight to improve urban governance for better policies and actions that would eventually enhance resilience building and therefore should be promoted broadly to make urban inhabitants proactive managers of the urban systems.

Keywords: complexity theories; social-ecological systems (SES); urban planning; risks; resilience.

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## Development of ASEAN Urban Resilience Checklist

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After the Sendai Framework adopted in 2015, more and more attentions are paid to Urban Resilience and disaster risk reduction (hereinafter referred as DRR) activities. However, most of the persons in charge of DRR-related measure planning in the local governments and communities do not have enough experience and expertise to implement proper DRR-related activity from the comprehensive viewpoint, which leads to have tendency to work with the easy and noticeable activities. Under this situation, the tool for logical and comprehensive DRR-related measure planning is strongly required. Based on this background, ASEAN Urban Resilience Checklist is developed as a part of outputs of the project components for Concept Note 18 (CN18): Building Disaster and Climate Resilient Cities in ASEAN. CN18 was under the strategy and priorities for AADMER Work Programme Phase 2 (2013-2015) formulated by ASEAN Committee on Disaster Management (ACDM). This checklist was developed and proposed in participatory planning manner through trial implementation of the draft checklist on three cities in ASEAN Member of States (AMS) and several workshops with AMS participants in order to gather opinions and comments for improvement of it. The checklist is proposed to compose of two parts of “Checklist A for Disaster Risk Management” and “Checklist B for Resilient Urban Development”, which two checklists requires automatically their assessments to be promoted by interactive and cooperative activities such as data sharing, common analyses and planning coordination with decision making between two sectors. This is because one of the issues on mainstreaming DRR into land use and urban development planning is observed by inefficient coordination and interaction of two key sectors of disaster risk management and urban sector including infrastructure in ASEAN. The checklists aim to provide users with a simple tool to assess the existing capacities of a target DRR and urban resilience, keeping in mind the capacities that local governments actually need in order to achieve effective DRR and urban resilience. The following three aspects are considered for formulating the checklists: 1) Quantitative assessment: Checklist plays a key role in enabling users to assess their DRR and urban resilience activities quantitatively and visually for prioritizing improvements effectively and efficiently. 2) Promoting actions: Checklist plays an important role in promoting required actions through association of weak items with prioritized actions for enhancement of DRR and urban resilience. 3) Compact form: Checklist aims to be compact with essence taking account of frequent use for daily activities of DRR and urban resilience. This paper illustrates the detail of this checklist and reports the actual result of Denpasar, Indonesia and share the lesson learnt.

Keywords: resilience; risk governance; checklist; disaster risk management, action plan.

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# Development of resilience improvement programs for a large university system: the case study of the Instituto Politecnico Nacional after 2017 Mexico earthquakes

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The last disastrous earthquakes occurred in Mexico on September 2017 linked to the population's increasing fear induced by the recent earthquake of February 16<sup>th</sup> 2018, showed the urgent necessity of implementing specific resilience programs for different type of communities (large urban cities, rural villages or coastal settlements) to facilitate the recovering of the normal life in the shortest possible time, adapted to the local conditions of any community. In urban cities, it is possible to observe a complex network of multiple systems (governmental, university, industrial, neighbourhood system, etc.) coexisting regularly making their ordinary activities without a particular delimitation between them. When an earthquake hits the network, the first reaction of each system is to protect individuals as members of their organizations, and secondly -more or less 30 minutes later- each individual tries to reach its relatives, producing an uncontrolled chaotic mobility where the systems might lose temporarily their figure of authority at least during the next two or four hours. During and after an earthquake event, a large University system possesses a set of features that makes itself especially vulnerable as well as a decisive resilient contributor to the recovery of the ordinary life in the urban region. The aim of this work is to present the application of the Five-Fingers Resilience Improvement Program (5FRI-Program) on a university campus (the largest Civil Engineering School of Mexico with more than 6000 students) as well as some of the original results obtained. The 5FRI-Program is a proposal for auto-organizing geographical-organizational-social delimited urban systems potentially affected by a combination of multiple hazards as earthquakes, hurricanes and/or flooding. The 5FRI-Program is integrated by five main points: 1) nucleation; 2) social survey and resilient core detection; 3) application of the Resilience-Based Design; 4) actions and decisions; 5) Implementation and retrofitting. The application of the 5FRI-Program on a university campus (the largest Civil Engineering School of Mexico) is presented in this work, as well as some of the original results obtained. The case study has a peculiarity that affected -and enriched- its application: according to the Program, the third step was being applied when the two large earthquakes hit Central Mexico in September 7<sup>th</sup> and 19<sup>th</sup>, 2017. Due to this, it was possible to configure and create a Civil Engineering Committee for Structural Safety as an active decision taken on the framework of the 5FRI-Program "Point Four: actions and decisions". It is expected that the 5FRI-Program be adopted for the rest of the Schools and Research Centres of the Instituto Politecnico Nacional, as well as the constitution of a larger Committee of Structural-Geotechnical Safety and Resilience for the whole Institute.

Keywords: resilience programs; Five Fingers Resilience Improvement Program (5FRIP); university system; 2017 Central Mexico Earthquake; Instituto Politecnico Nacional.

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## Risk governance: coordination, inclusion and protection with and for European cultural heritage

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The historical and cultural heritage might be in danger due to various reasons, including the lack of awareness, economic crisis, terrorism, natural and climatic changes, and mass tourism. Diyarbakır Fortress and Hevsel Gardens nominated as UNESCO World Heritage Site, in July 2015, had experienced many attacks in 2015 and 2016. Therefore, the reasons to choose this topic are as follows: (1) terrorist attacks started in 2015 created dangers in the preservation and protection of the cultural and historical heritage; (2) security risks in the area of historical and cultural heritage (i.e., thief, narcotic crimes); (3) based on the opinion of the Ministry of Environment and Urbanisation, there is a need to integrate the on-going process of preserving, conserving and reconstructing/design of the cultural and historical heritage sites with the society and local life; and to touch to the society; (4) during the process of reconstruction, new historical traces were found and thus the urban construction was currently stopped; (5) with regards to local economy, terrorist attacks resulted in an economic decline in terms of tourism in specific and the local economy in general; (6) based on the priorities mentioned by the Ministry of Environment and Urbanisation, there is a need to design, plan, orient, implement and facilitate the traffic routes in order to establish a secure traffic to ensure the safety of the historical and cultural heritage. This paper aims to create a model to ensure public participation with adaptive governance with multiple stakeholder platforms. Two original contributions of this paper is first to create a new model/modelling to preserve, protect and reconstruct/design of the historical and cultural heritage; second, to create a roadmap to be implemented it in other regions. This paper is based on face-to-face qualitative interviews conducted with researchers, policy makers, private sector representatives, the general public and specialized communities such as art curators, galleries, art historians. This paper reveals the need to create a social platform with an outreach that will produce benefits for a broad community and to raise the awareness of local pollution toward cultural heritage.

Keywords: risk governance, cultural heritage, security, citizen participation, societal integration.

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## Regulatory mechanisms in intergovernmental relations and citizenship in risk governance in Portugal

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Characterized by a type of intrinsically hierarchical risk governance model (Ribeiro, 2018), the Portuguese civil protection system presents, in the political domain, a vertical verdict, of a prescriptive nature, in intergovernmental relations between the central administration and the local levels. This hierarchical model is also reflected in the respective dimensions of citizenship, where, according to narratives and institutional discursive logics, *de jure* rights predominate, not always accompanied by *de facto* rights. However, the involvement of populations in the system continues to be subordinated, with individuals and communities appearing more as receptors and object of a system than as protagonists and subjects of actions. This is an area considered as a field of action for experts, only rarely open to effective participation of populations. This article seeks to discuss the causes and consequences of two specific types of risks and catastrophes, forest fires and earthquakes, highlighting not only their similarities, but also their differences, regarding risk governance processes. About forest fires, it should be noted that the events of June and October 2017 have become a significant moment in the history of catastrophes in Portugal. Apart from the disastrous consequences of the high number of human victims, destroyed assets and burnt-out hectares, their effects have subsequently spread in the political, social and economic dimensions that seem to reconfigure the existing risk governance processes, particularly about the exercise of an inclusive citizenship. In the same way, and assuming a significant weight around the mechanisms of risk governance, has been the debate centred around the seismic risk, due to the recovery and rehabilitation processes of part of the buildings in Lisbon, resulting, among other factors, from the tourism development processes that the country, and the city, have been registering. Highlighting also intergovernmental relationship processes, namely in terms of production and legislative application, this situation has amassed a wide discussion on the part of professional groups and the population in general, in a communication process mainly centred in the domain of specialized protagonists, not always decoded for lay populations. On the one hand, the dichotomy between agents and regulators will be highlighted in the presentation and at the level of intergovernmental relations, discussing the main analytical and explanatory domains that make it possible to identify the differences, similarities and even antagonisms between these two levels of State administration. On the other hand, and in relation to the areas of citizenship and public participation, the two processes will be discussed, in a double assertion, and based on the reference of the right to have rights, the configurative processes of contractual mechanisms, as a matrix for the inclusion or exclusion of citizens in risk governance processes.

Keywords: risk governance; intergovernmental relations; citizenship.

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## New York City's Flood Resilience Zoning Outreach Process: from community awareness to community empowerment

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How far will a city go to integrate public participation in developing climate policies? While recent international frameworks for disaster risk reduction have shifted the emphasis from local knowledge towards data and technological advances, New York City's Flood Resilience Zoning Text Amendment highlights the importance of public participation in shaping the City's risk policies. The Flood Resilience Zoning Text Amendment incorporates special zoning regulations that apply in the floodplain to promote resilient construction. With 835 kilometers of waterfront, New York City cannot solely retreat. Its resiliency strategy explores a multi-layered defense approach, which includes investments in coastal protection and infrastructure, community preparedness and flood resistant construction. The floodplain impacts a large geography and includes more than 400,000 residents. The biggest challenge is that the high-risk areas include all land uses and building types, from low to high-density communities distributed within 50 of the 59 community boards. Therefore, the City could not come up with one single zoning approach, but had to lead several initiatives, which included detailed analysis of residential, commercial and industrial buildings, in addition to 10 neighborhood specific studies to further identify particular issues and challenges these areas faced when hit by Hurricane Sandy in 2012. Historically, the Uniform Land Use Review Procedure has been the process to incorporate public participation in major land use and zoning changes in New York City. However, in order for the City to develop its long-term resiliency plan, Department of City Planning invested in an additional outreach effort that preceded the formal process throughout 2016 and 2017 to explore concerns from communities in the floodplain. This process resulted in over 110 public meetings that included various stakeholders: from residents, business owners, and civic groups, to architects, engineers, elected officials and community boards. This effort challenged the agency to come up with new tools for engagement since the strategy needed to go beyond risk awareness and focus on collecting detailed feedback on how residents see their neighborhoods and building stock adapting to flood risk overtime. Carefully designed table activities used during workshops simplified complex zoning and construction regulations and empowered participants by enabling them to make decisions and visualize the physical changes necessary to increase resiliency. This process was effective in collecting individual experiences, ideas, and neighborhood priorities. As a result, the agency was able to obtain a comprehensive understanding of issues people face, varying from physical building constraints to financial challenges. Finally, the project kept communities engaged through constant dialogues and updates, which ultimately led to an outreach summary document that was returned to the public and is informing the zoning proposal. This work will showcase the various strategies the City used and will summarize the results of this effort, especially how this participatory process has been closely shaping the development of zoning rules and land use strategies to reduce flood risks in New York City.

Keywords: flood resilience; climate policy outreach; community empowerment; public engagement; zoning and land use.

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## Disentangling governance in resilience projects: lessons in process based planning from the Philippines

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Following Typhoon Haiyan in 2013 – one of the strongest tropical typhoons ever recorded – the city of Tacloban in the Philippines was left decimated. Donated funds streamed in from around the globe, yet governmental agencies with overlapping responsibilities experienced overwhelming difficulty implementing longer-term recovery strategies. In 2016, One Architecture and Urbanism, in partnership with the Philippines Reclamation Authority (PRA) and Wetlands International, was awarded a Water Window Seed Grant from the Global Resilience Partnership (GRP) to implement a series of pilot projects for mangrove and beach forest restoration throughout the coastal area. Mangroves are touted for their multiple-level ecosystem services, boosting biodiversity, encouraging sediment accumulation for coastline stabilization, acting as a strong wave attenuator to mitigate storm impact, and fostering economic opportunity. However, while reforestation has been a common goal throughout the Philippines, in practice, our project team encountered municipal and governmental obstacles that led us to reconsider strategies for implementing nature-based projects at a much larger scale. Recognizing the importance and applicability of disentangling these processes to pave the way for similar efforts in the Philippines and beyond, we refocused our scope to document the intricacies of local governance, leverage science-based methodology to build from existing efforts, and test public-private partnerships similar to those we developed to smooth and drive forward resilience projects nationwide. To date, two rehabilitation pilot projects have been established near Tacloban City under the grant: a beach forest planting of nearly 25,000 seedlings, and a mangrove planting of nearly 10,000 seedlings. Many of the obstacles our international and local team encountered throughout the year-long grant were the result of external factors including political and policy-based developments ushered in with a new federal administration, redundant and needlessly complex bureaucratic and administrative procedures, a near-impossible site selection and verification process given the complexities of land ownership and tenurial status after the devastation of Yolanda, and unforeseen environmental challenges, such as the success of agency-led planting practices doomed to failure because the wrong species was selected for a given coastal ecosystem. Throughout this process, trust-building with local units of governance and tapping into vernacular best practices has played a major role in the team's work in Tacloban, influencing our decision-making process at every step, from triaging sites to widening our scope. With a resolute focus on creating local benefit alongside a framework for the long-term maintenance and viability of projects, we have understood that a re-ordering of intergovernmental relationships (and communications) is key in lending structure, clarity, and accountability to resilience projects.

Keywords: Typhoon Yolanda; resilience planning; disaster governance.

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## Effects of legal frameworks in the resilience of coastal towns under tsunami hazard: governance in the Southeastern Pacific Coast of Chile

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Disaster governance is a characteristic of resilience, referring to the interrelated set of institutions, instruments, norms and actors to reduce the impacts of a disaster. As governance has been fragmented in developing countries, the concept of governability has emerged, referring to a state of dynamic equilibrium with a multidimensional character and emphasis on the construction of a legitimate and effective response between the market, state/government, and the demands of the civil society. On the Chilean coast, it is important to explore whether the response to disaster tends towards governance or governability since the regulatory framework has not considered the capacity of the territory and population. This problem was explored after the 2010 tsunami, when various territorial planning instruments were developed to increase resilience. Hence, the objective of this study was to explore the normative and spatial orientation of territorial planning instruments, and to contrast the results with the capacity of the territory. A content analysis was undertaken of the regulatory framework of 14 coastal villages (N=19 instruments) using 21 resilience indicators in respect to the physical, social, ecological and perceptual dimensions of resilience. By using the Atlas-TI software, we obtained codes and themes related to resilience (e.g. redundancy), which originated semantic networks, and allowed interpreting the orientation of the instruments towards resilience in a quantitative (e.g. frequencies of mention) and qualitative manner (e.g. redundancy of evacuation routes). Subsequently, the information was spatialized using GIS and contrasted with spatial information on the capacity of adaptation of the territory in case of tsunami. First, results indicated that the orientation of the instruments to resilience is positive as well as negative, i.e. regulations that contribute to and obstruct resilience were found. Second, the extent of the orientation of the instruments varies; while the Communal Regulatory Plan influences all resilience dimensions, the Civil Protection Plan in case of Tsunami, and the Regional Emergency Plan, influence the physical and social dimensions respectively. Finally, the instruments support the most aspects of the territory referring to the physical (e.g. evacuation routes) and social dimensions (e.g. emergency staff), and to a lesser extent those linked to the perceptual dimension (e.g. perception of risk). In contrast, instruments do not provide regulations in respect to the ecological dimension of resilience (e.g. sand dunes, coastal forests). Accordingly, although there is an orientation of the current regulatory framework regarding the resilience of coastal communities, this orientation is weak and counterproductive, especially considering that the instruments do not establish norms binding among themselves, there are no instruments that assure the role of the ecological dimension of resilience and, above all, that consider the ability of inhabitants to adapt in terms of how they perceive and use their territory in the event of a tsunami. Overall, results indicate a tendency to governance over governability, and at the same time, shed light on the aspects (i.e. indicators) that influence on this, facilitating decision-making and funding allocation to improve the adaptation of human communities in cases of disaster.

Keywords: governance; resilience; tsunami; resilience indicators.

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## 2017 coastal El Niño in Peru: an opportunity to analyse the influence of hazard mitigation plans on local resilience

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The challenge of ensuring that disaster risk information is effectively translated into knowledge, decision making and the consequent increase of resilience has not yet been overcome. Hazard mitigation plans are intended to help localities understand their disaster risk and identify actions to reduce it. However, despite the existence of studies that measure the quality of these plans in different countries, studies measuring the influence of this quality on the resilience of localities are lacking. Therefore, this ongoing research aims to identify the influence of the quality of these plans in (1) the reduction of direct damages and (2) the increase in the rapidity of recovery from a disaster, two important factors in the definition of resilience. For this, a methodology with two levels of analysis was proposed. In the first, the variables of quality of the plans (QPI) and level of implementation (LII) are correlated with the variables of level of damage (LDI) and rapidity of recovery (RRI), of an affected localities group. In the second level, two localities are selected (the highest and the lowest LDI), to apply multiple techniques, mainly qualitative. As application case, was chosen, the 2017 coastal El Niño heavy rains event in Peru, considered the third most intense “El Niño Phenomenon” of the last 100 years, and which left more than 1.5 million affected and 1.6% of the GDP in losses. So far, in the first level, the variables of QPI and LDI have been analysed in 5 localities (of 15 selected), finding a low correlation ( $R^2 = 0.04$ ). However, when disintegrating QPI in subvariables corresponding to quality categories, it was observed that the quality categories of “policies and proposed actions” ( $R^2 = 0.15$ ), and “fact base studies” ( $R^2 = 0.25$ ) would be the most influential in the reduction of damage. In the second level, the cities of Piura and Sullana were analysed, in which the spatial distribution of affected dwellings, the risk map of the plan and the land use zoning maps in force were contrasted. Through this, specific areas were identified in which the plan would have effectively contributed to harm reduction or which would need corrections in the risk estimation. The pending activities correspond to include, in the first level, the analysis of the ten remaining localities and the LII and RRI variables; and in the second level, the development of field inspections and key informant interviews. The culmination of these activities will allow to consolidate the findings. It is emphasized that the proposed methodology can be applied in other countries and with other types of hazards, allowing an effective improvement of the plans and their implementation process, after a disaster occurrence.

Keywords: hazard mitigation plans; local resilience; plan evaluation; coastal El Niño.

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## Defining risk across borders: engaging information technology for cross-border disaster collaboration

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Disaster planning and mitigation are increasingly becoming projects based in managing diversity, from cross-organisational collaboration to inclusivity of voices. These issues are particularly prevalent when dealing with transnational risks. The challenge, however, is not just that more natural, technological, or social hazards are increasingly crossing borders thus more sharing between diverse actors is needed for proper disaster governance or that there is an increased risk to citizens if data is not shared over borders. It is also that borders – national, jurisdictional, or institutional – are increasingly playing a role in how we organize information and understand risk. Moreover, these understandings of risk are being built into the tools used by disaster responders, which can have a range of implications from how accuracy and relevancy of information is defined to increasing the exclusion of already marginalised understandings of risk. Building on research from a European project to design technologies for cross-border interoperability in disaster training and preparedness (IN-PREP.eu) this paper explores what it means to define risk management by using borders as a frame. It draws upon the qualitative results of the project's ethical impact assessment based on stakeholder consultations that describe and map information flows within the design ideas, identify key stakeholder interrelationships, and assess social norms, legal frameworks, and ethical considerations. Specifically, this paper examines the assumptions that emerge in designing information technology and their infrastructures to support cross-border decision-making, preparedness, and disaster management. The paper explains how different understandings of risk become codified into the algorithms and software frameworks and identifies the emergent social and political tensions that can form as a result of these new analytical tools intended to support cross-border interactions. Finally, it discusses how the tension between borders and designed collaboration reveals nuanced challenges around the ethics of responsibility, care, and contestation around risk.

Keywords: borders, risk, preparedness, information technology, ethical implications.

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## TRACK 2C

### Public and private initiatives in Disaster Risk Reduction (DRR) activities

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## Building resilience to natural disasters using financial instruments

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The emergence of environmental issues from global warming and the increase of natural disasters requires a global approach that integrates the sustainability concerns into the economy. The implementation of sustainable development involves the use of dedicated financial instruments both from the public and the private sector, which may be triggered using appropriate indicators, to address the needs which arise when natural disasters takes place and facing other environmental challenges. These financial solutions ought to be clearly identified, defined and budgeted to be used in an integrated way and at the right time. An important element to be considered is the transfer of risks between participant actors which may adopt different forms of partnerships between the public and the private sector. This research aims to conceptualize and identify the different type of financial instruments, traditional and innovative solutions, actors, funds and agreements, and possible forms of public- private partnerships, to improve the resilience of the society against natural disasters. By reviewing traditional post-disaster arrangements and innovative pre-disaster financial instruments, as well as partnership forms to integrate different actors, it is observed how risk financing may complement and promote risk reduction. The promotion and establishment of public-private partnerships are essential to better engage the private sector in disaster risk reduction fostering a culture of disaster prevention and benefit from technological and innovative solutions. The analysis is based on: a) a literature review, mostly to conceptualize and define the elements and scope of the research; and b) a case studies search, from which main barriers, key limitations, relevant lessons and best practice, that features the links between public-private partnerships and disaster risk reduction, may be extracted using mostly qualitative analysis over a number of cases. This research involves to analyze the dynamics of possible financial instruments to identify the current state of art, future trends and possible recommendations for policy-makers. The results illustrate how public-private partnership projects may be evaluated to extract conclusions about the applicable solutions to provide financial solutions adopting this types of schemes. In sum, the paper involves the conceptual definitions of financial instruments for covering losses and economic damages from the occurrence of disasters, the identification of actors and funds, activities of the actors, initiatives following the Sendai Framework for Disaster Risk Reduction, and innovative solutions to engage the public and private sector. This engagement should be done in an integrated form which can greatly contribute to make the society more resilience towards the recurrent natural phenomena which affects specifics geographical areas.

Keywords: financial instruments, disaster resilience, public-private partnerships, disaster risk financing mechanisms, disaster risk reduction.

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## Business continuity as a means to strengthen Disaster Risk Reduction (DRR) in a coastal community of oyster farmers

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Oyster farming in the Philippines is an important livelihood in many coastal communities which are usually composed of fisher folks and informal settlers that are among the marginalized sectors of the country and are most vulnerable to natural hazards. The Philippines sits in a region where hydro-meteorological and geophysical hazards are common and often lead to disasters. Thus, disaster risk reduction measures (DRR) are important in order to prevent loss of life and reduce damage to properties. The study focuses on the DRR initiatives between Ipil Action Group, an association of fisher folks living along the coast of an estuarine environment and Agricultural Sustainability Initiatives for Nature (ASIN) Inc., a start-up company whose mission is to provide high quality, traceable and sustainable agricultural produce using environmental friendly sound practices. Basic geological hazard assessment of the study site using available maps and data from government agencies and institutions were done and its potential impacts to the oyster supply/value chain and business continuity were evaluated. Business continuity strategies were then suggested based on identified gaps and potentials for collaboration. One of which is the promotion and distribution of a more disaster resilient oyster growing method combined with a timely and accurate multi hazard early warning system (MHEW). ASIN and Ipil Action Group is developing a simple and open communication system using cellular phones whenever there are severe weather systems that may affect the area. This early warning system communication protocol will also apply for tsunami warnings and other instances where critical information needs to be relayed to the community as soon as possible. This initial activity to ensure the safety of their disaster resilient oyster rafts and their livelihood during typhoons served as a springboard to strengthen DRR in the study site. Concerns on environmental protection and management also surfaced during collaborative discussions which highlight their understanding of how environmental quality will affect their livelihood of oyster farming and how environmental degradation may exacerbate the impact of disasters. These concerns are in resonance with the Sendai Framework as it broadens the scope of disaster risk reduction to cover environmental and biological hazards and risks and the promotion of health resilience. The ongoing and proposed business continuity initiatives to address the identified gaps are anchored on a close collaboration between the community organization, business sector, government and higher educational institutions (HEI) which hopefully will enable capacity development. Optimistically, these initiatives will lead to a resilience within the community which covers geologic hazards, health, sanitation and the environment. Business continuity and DRR initiatives are hand in hand in increasing the resilience of partner community organizations to disasters by enabling them with proper knowledge and continuous support. Sound and sustainable business practices can provide stable, long term livelihood opportunities which will also be able to reduce the risk of the oyster farmers to disasters by helping them overcome poverty.

Keywords: coastal hazards; oyster farmers; business continuity; DRR

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## Risk of flooding: precautionary actions of villagers living in flood-prone rural area

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People living in areas prone to natural hazards generally do not learn lessons from past experiences of natural hazards and may not take precautionary actions to secure their future. There are some studies related to this theme based on experience in developed countries. However, doing research on this theme in developing countries such as Sri Lanka is very important because the frequency of occurrence of natural hazards is an increasing trend in countries like Sri Lanka. Additionally, empirical findings show that a significant percentage of monetary damage due to natural hazards can be reduced through precautionary actions. The objectives of this paper are twofold. First, it is to identify why only some people living in flood-prone rural areas take precautionary actions while others do not take any action. Second, it is to identify the type of precautionary actions taken by people. The study is based on secondary and primary data collected from the Kudaligama Grama Niladari Division which is situated in the Kaluthara District in Sri Lanka. The village is affected by floods every year. Secondary data were collected from the Divisional Secretariat and the Grama Niladari office. Primary data were collected through a sample survey. A socio-psychological model based on Protection Motivation Theory (PMT) was used as a main analytical tool. The findings show that about 35 percent of households have taken precautionary actions in order to mitigate damage caused by floods. Taking precautionary action is the optimal strategy for them as floods cause huge damages to their houses and household utensils. The most popular precautionary action is structural change of the home. Some people have built two-story houses. Some have increased the height of the foundation. Most households of the less-educated poor community have not taken precautionary actions. Some of them want to take action but they do not have the financial capacity to do so. Hence their decision is not an optimal decision. Others did not take any action as they are used to living with floods. They consider floods as a 'golden water' as they receive a lot of donations during the flood period. Hence, not to take precautionary actions is an optimal strategy for them. Some households want to take actions but they do not have the financial capacity to do so. Hence the government or other stakeholders should support them to take precautionary actions. As for the other group that considers its decision is an optimal decision, there should be a separate program to motivate them to take action.

Keywords: precautionary actions; flood preparedness; optimal decisions; natural disasters.

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## Resilience through insurance: a comparison of the role of insurance in flood resilience for households and businesses in England

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Resilience to flooding is influenced by adaptations or behaviour that address risk reduction at all stages of the disaster cycle. This includes: physical adaptation of buildings to limit damage; individual preparedness and business continuity planning; and provision of resources for reinstatement through insurance or recovery grants. In the UK implementation of such strategies lie mainly with private property owner and their private insurer while government policy promotes greater uptake by these actors as part of an integrated strategy. In the context of increased flood events the provision of affordable market based insurance has been increasingly challenging and in 2016 a new insurance arrangement (Flood Re) was put in place to support transition to affordable market based insurance. However, Flood Re is specific to residential property and excludes many categories of property previously guaranteed cover including small businesses. The research used a survey of frequently flooded locations in England to explore the different experiences and behaviour of households and businesses at risk from flooding with respect to insurance and recovery in this evolving scenario. The results show distinct differences between households and businesses that could point to greater opportunities for enhancing resilience if policy and practice recognised those differences.

Keywords: businesses; insurance; flood risk; risk management; residential; recovery.

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## TRACK 2D

### Understanding disaster recovery processes

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# Can social-security measures build resilience against natural disasters? A case study of flood-affected district in Uttarakhand, India

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Social security and disaster resilience are closely interlinked particularly in regions that are highly prone to natural disasters. The existing literature suggests that appropriately designed social security programs can enable households living in disaster prone zones to adapt to their livelihood uncertainties and help cope with the negative impacts by developing strategies of livelihood diversification, and adapting local measures for disaster risk reduction. However, development and disasters are also closely related as both significantly affect each other. Development can increase or reduce vulnerabilities, can open windows of opportunity, and catastrophic events can set back development process. In view of this, the paper examines the role of social security measures of livelihood, food security and social assistance namely Mahatma Gandhi National Rural Employment Guarantee Scheme, Public Distribution Scheme, and Old Age Pension Scheme, in contributing as tools to build household resilience against recurring floods. Further, the paper also focuses on how unplanned development in Uttarakhand has multiplied the existing vulnerabilities of the already fragile region. The rural poor households are worst affected as they have been exposed to multiple hazards and have been deprived of mainstream development. The paper has taken the devastating floods of 2013 as case study. The study is located in Rudraprayag district, one of the worst affected regions due to the flood. The study has qualitative research design and opted for targeted sampling method. The sampling method selected 30 households which suffered from the disaster and have been entitled to social security schemes. Over a period of three months, 30 in-depth interviews have been conducted with the households which inquired about their lived experience of the disaster, collected their opinions on the ongoing development and its impact on the local environment, and role of social security measures in creating assets at the household level. In context of inclusion of disaster resilience in India's development strategies, the paper aims to produce policy implications, and bridge the literature gap in disasters and development discourse.

Keywords: Household resilience, social security, natural disasters, adaptive social protection.

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## Identifying key factors enabling disaster recovery of households

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The ‘recovery’ is considered the least understood phase in the disaster risk management cycle. So far little research focused on identifying the key factors that enable recovery processes of households. However, we consider the period after a disaster as a critical one which determines whether an affected household will regain its functions or not. Essentially, returning back to only the pre-disaster level means that a future hazard with the same intensity will cause the same amount of destruction. Thus, ‘successful’ recovery processes need to deliver an increase in the ability of households to deal with a similar type of hazard in the future. Accordingly, households that better recover from a disaster likely reduce their risk exposure and become more resilient. In this study, we first review the critical factors that may influence whether households perceive a recovery process and outcome as more or less positive. These factors include aspects related to the recovery time, risk exposure, level of education, involvement in recovery process, etc. of households. In a second step, we analyse through a case study-based approach how people in Chennai, India, recovered after the 2015 South Indian floods. Through a household survey (n=521) conducted in two affected areas ten months after the disaster occurred, we collected information on how affected households perceived the recovery process for rebuilding their houses. We analyse those data by using binary logistic regression analysis to identify which factors made people evaluate the recovery outcome of rebuilding their house as better than before. Key results from this study show that the recovery outcome for rebuilding the house was perceived as better by households with lower education levels, located in the more affected area, lower sense of responsibility to protect their house and those who needed less time to rebuild their house. Another key result shows that households who were more satisfied with their house recovery process include those who were more involved in the recovery planning and whose house was less damaged. Based on these results, we identify that the recovery process was ‘successful’ for households whose house only had minor damages, are living in risk prone areas and with lower education levels. This implies that those households were able to build resilience and thus, their houses are likely better prepared against a future flood hazard with equal intensity. We conclude this study with a discussion about which factors (e.g. participation in recovery planning) contribute to a successful recovery process and what is needed to build resilience against disasters.

Keywords: disaster recovery; recovery processes; floods; Chennai.

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## Social capital in disaster recovery: a case study after the 2016 earthquake in Ecuador

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Research about Social Capital (SC) in disaster recovery has gained importance in recent years. This is due to the increased recognition of adverse disaster impacts on human security. Along with this, a paradigm shift took place in the understanding of Disaster Risk Management (DRM), from a strong focus on physical aspects towards a more integrated approach that also considers social aspects. SC is defined through the functions networks, trust and norms. In April 2016, an earthquake with a magnitude of 7.8 on the Richter scale hit Ecuador and left 720,000 people in need of help. This paper examines the role of SC in the recovery process of two affected cantons Jama and Pedernales. We collected data on SC among survivors of the earthquake in Jama and Pedernales through a household survey ten months after the disaster. We then analysed through statistical analysis different functions of SC, such as trust, networks and community activities and looked for correlations with the state of recovery and recovery satisfaction. Our results show that ten months after the earthquake many people were still dissatisfied with the state of recovery. In contrast to other studies, we found positive correlations between vertical SC (trust and networks to authority figures such as national government) and recovery satisfaction, while SC on a community and individual level showed only weak correlations with recovery satisfaction. People who trusted in authority figures and had easy access to authority figures were more satisfied. At the same time, collective action and mutual support was mainly observed within individual networks, while collective action on a community level was minimal. This might be traced back to a lack of Community-based Organisations (CBOs) in the area and to weak trust among community members. The government implemented a rather top-down recovery plan with minimal inclusion of local actors, which additionally reduced collective action among community members. This was reflected in a slow recovery process and low recovery satisfaction. Thus, we suggest the strengthening of SC on a community level by promoting CBOs and trust among community members and by involving people in the recovery process. This may lead to more collective action at the community level, what in turn would support a quicker and more sustainable long-term recovery process.

Keywords: disaster recovery; social capital; recovery satisfaction; community activities.

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## An investigation of disaster preparedness of micro-, small- and medium-size enterprises of Sri Lanka

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Natural disasters have created a significant adverse impact on Micro, Small and Medium-sized Enterprises (MSMEs) in Sri Lanka during last decade. MSME sector can be considered as the highly vulnerable section of Sri Lankan economy which affected drastically by the natural disasters as they are relatively resource constrained and less resilient. With the awareness of the potential dangers from natural disasters, the government has been taken many initiatives to help the industrial sector prepare, adapt and respond. Unfortunately, MSMEs are excluded from most of these initiatives. Therefore, MSMEs do not have adequate information or contingency plans for risk associated with natural disasters. Given that community resilience depends greatly on the ability of the MSMEs to bounce back, re-establish production and continue to provide employment to local workers in the aftermath of disasters. Therefore, disaster preparedness of MSMEs is critical. This study sought to investigate the level of disaster preparedness of MSMEs located in Western province of Sri Lanka. Two hundred randomly selected MSMEs from Western province were surveyed for this study. Semi structured interviews were carried out in person with the business owners in order to identify their experiences on various types of natural disasters faced by them, and their status of preparedness for such natural disasters. It was found that during the last ten years (2007-2017) 52.2 percent business enterprises had averagely been struck by natural disasters. The most common natural disaster in this province was flooding and Colombo district had been the worst adversely impacted following Kalutara and Gampaha districts. Loss of earnings was the most massive damage of the enterprises following damages to buildings and equipment. One of the major finding was the assessment of preparedness of MSMEs to natural disasters can be categorized into four elements: preparedness assessment, natural disaster prevention planning, staff training, and asset prevention and risk insurance. The study revealed that preparedness of MSMEs for the aspect of preparedness assessment was low with the average of 2.752 of 6-point score. Natural disaster prevention planning was evaluated with 12 manoeuvres resulting low overall scores. The study found that there were no regular personnel training on what to do during disaster breakout and staff knowledge on mitigation of damages during disasters was around 20 percent. Asset prevention and risk insurance was also showed low scores similar to other 3 elements. From this study it could be concluded that of all the 4 elements of disaster preparedness of Sri Lankan MSMEs were low and among these 4 elements, natural disaster prevention planning showed the highest score. The study concludes that the Sri Lankan MSMEs were having little preparation on natural disasters. Enhancing the level of disaster preparedness can better mitigate, prepare for, respond to, and recover from natural disasters more effectively. Therefore, this study concludes with providing some recommendations on enhancing disaster preparedness in the MSME sector in Sri Lanka.

Keywords: micro, small and medium enterprises; natural disasters; disaster preparedness.

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## Risk perception and capacities for DRR of people with migration background in two Austrian case studies

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In the context of disaster risk reduction (DRR), people assess information differently and take action on different issues (UNISDR, 2017). Although research has identified immigration as an important dimension of demographic change that needs to be taken into account in the communication of natural risks (Martens, 2009) and that migrant are considered a vulnerable group, further research on diversity aspects of DRR is scarce in Europe. Within the project “CCCapMig”, an interdisciplinary team researches coping capacities, risk perception and the level of preparedness of people with migration background in the context of natural hazards, focusing on the impacts of floods and heavy precipitation events. The study aims at exploring the underlying effects of vulnerability of this group before, during and after the disaster recovery process outlining challenges and capacities. This provides a basis to develop recommendations for tailored risk communication strategies for stakeholders in DRR and the target-group itself. The research is carried out in two case study regions in Austria, where high exposure to natural hazards, historical flood events and a long tradition of labour migration coincide. This contribution describes an interdisciplinary approach which combines methods of social and spatial science and outlines the obstacles during the research process, in particular reaching people with migration background for interviews and focus groups. Short street surveys and interviews with inhabitants living in hazard zones, focus group discussions and detailed family surveys were combined with an analysis of the built environment and open spaces as well as the exposure to natural hazards. In addition, expert interviews with stakeholders involved in disaster risk management, complemented by an analysis of structural factors, demographic data, current risk communication strategies and legal instruments were carried out. The theoretical background for the research design was co-created at the beginning of the project and integrated the Protection-Motivation Theory after Grothmann and Reusswig into the Sustainable Livelihoods framework of the FAO adapted for disaster risk management. The interpretation and discussion of the data revealed the diversity within migrant groups and that ethnicity is often not the prevailing factor that determines vulnerability. Age, gender, the level of education, economic capacities and social capital as well play an important role for the capability to recover from past and prepare for future events. Surprisingly, language skills or the lack of it are not an obstacle within all phases of the risk cycle. However, during the prevention phase poor German skills make it more difficult to understand private households’ adaption measures and to participate in communal decision-making processes. In addition, natural hazards are associated with a low probability of recurrence and rank low compared to other (daily) risks and struggles among people with migration background who have not been affected recently. The research also shows that there is not the one ideal channel to communicate risk; instead a variety of approaches reflecting the diversity within this target-group is needed.

Keywords: vulnerable groups, migrants, risk communication, disaster risk reduction, capacity building.

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## Children's role in disaster preparedness, response and recovery: a pilot study in Chennai, India

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Children represent the largest population segment in low- and middle-income countries (LMICs) and are often the first and most affected victims in natural disasters (Norris et al., 2002). Lack of basic resources such as food, shelter, and social support, coupled with an inability to make sense of their surroundings leads to decreased ability to cope and increased vulnerability. However, children can also play an active and valuable role in the development and application of strategies and practices to minimise disaster risk and vulnerability (Amri et al., 2017; Ronan et al., 2016). The United Nations Sendai Framework has recently identified children and youth as agents of change and advocated for their active involvement in preparedness activities (UNISDR, 2015). Although there is preliminary support for this stance (e.g. Amri et al., 2017; Ronan et al., 2016), it has not yet translated into larger scale, action-oriented, active involvement of children, worldwide, including in India (e.g. Joerin, Steinberger, Krishnamurthy, Scolobig, 2017). The objective of this project is to involve children actively using a participatory approach to develop a disaster resilience education programme to increase their and their community's resilience to natural hazards. This mixed methods study is being conducted in the inner-city flood-affected communities living in poverty, Chennai, India. We use participatory research methods as the key approach to engage children and the community. We held two focus group discussions with children (N=18) focusing on their experiences during the flood, how it shaped them, consequently their thoughts about preparedness for such events and their own role in it throughout the cycle of a disaster. A smaller group of children (N=10) and the first author have been meeting as an informal group, once in two weeks on an average to co-develop a disaster education intervention. Quantitative data on the children's knowledge of hazards, their fears, worry and their views on how prepared they are for common hazards in their area are being collected as well. Preliminary results from the development of the intervention indicate that children enjoy the process of participation. They also identified areas that need adult intervention and potential support systems in order to fill that gap. Children co-developed the education intervention with a focus on interactive and creative methods of learning – with the use of street plays, song writing, and interactive theatre. Children's active involvement in creating this intervention has shaped its structure and content, making it interactive and fun. Children are truly innovative agents of change with an enthusiasm to engage meaningfully in disaster preparedness activities. However, sustaining this enthusiastic participation in the medium to long term is a challenge – interest and support of their participation from their family, school/extra-curricular activities and the child's own commitment are some of influencing factors to their continued participation.

Keywords: disaster preparedness; disaster resilience education; child participation; CC-DRR.

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## Recovery from debris flows after Typhoon Morakot: the hot-spring hotels in Taiwan

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Past literatures suggest that social capital plays an important role in post-disaster recovery. However, very few studies use social capital perspective and focus on the industry recovery process in microscopic point of view, especially for the hot-spring hotels in tourism destination. Typhoon Morakot hit Taiwan in 2009 with 2,965 mm rainfalls in 4 days, which led to mass landslides and debris flows in southern Taiwan and caused nearly 700 deaths. Liugui District in Kaohsiung City was a famous hot-spring tourism destination. Roughly 20 hot-spring hotels were in this area. The debris flows caused by Typhoon Morakot directly impacted seven hotels and surrounding areas. The mainly access road was interrupted for more than 15 months. In this study, we conducted literature review on the element of resilience, and its relationship between social capitals. We used eight factors, including “income diversity”, “inter-social capital”, “neighborhood relationship”, “partnership with professionals”, “hazards perception”, “information and learning”, “other outside lineage” and “disaster-recovery strategies”, as an analytic framework to exam the recovery process the hot-spring hotels. This study chose four hotels as case studies and using depth interview and filed visit methods to understand the previous 8 factors that influencing the performance of hot-spring hotel recovery process. The results showed that the “income diversity” and “inter-social capital” of the hotels are important factors to influence the recovery. The “income diversity” refers the hotel has diverse revenue from diverse service items/marketing channels/customers types. The “inter-social capital” refers the hotel has support from families, the education level of the business owner and the hotel’s financial condition. In addition, this study finds that “access road condition” and “tourist attractions condition” are also important factors which even beyond all the factors of the social capitals.

Keywords: disaster recovery; resilience; Typhoon Morakot; hot-springs hotels; Taiwan.

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## Moving from response to recovery: what happens to coordination?

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Disasters of any scale gather different stakeholders. Some of them are involved only during disaster response, some of them during disaster recovery and many of them are involved in the entire process of disaster risk management. This paper aims to explore the differences in coordination during disaster response and recovery. Although coordination is not a new theme in disaster risk management, it has not been studied much in recovery settings. The study uses qualitative semi-structured interviews with stakeholders involved in managing the effects of the tsunami of 2004 in Tamil Nadu, India. Twenty-four interviews with fourteen respondents conducted in February 2010 and March 2011, are used for this study. The study illustrates that despite unclear boundaries between coordination during response and recovery, the respondents express substantial differences in (1) the variety of stakeholders. There is a quantitative and qualitative shift in the nature of stakeholders involved from response to recovery. This is also due to the fact that during disaster response the majority of the stakeholders have a common goal of providing basic services. However, the study reveals that there are changing goals due to sector related activities during recovery. (2) the level of engagement in activities- the findings related to the level of engagement also identify a sense of urgency in coordination as one of the important factors for high engagement during relief activity (3) the changing information need and requirement- information needs are different during disaster response and recovery. During response, the information needs are mainly directed towards the common goals of providing services to the affected communities, whereas, during recovery, information is directed to cater to different sectors. (4) the nature of coordination revealed two major approaches (logistics-based and approach-based) that take prominence during response and recovery respectively. This mainly relates to that one of coordinating logistics during response and the other as coordinating strategies during recovery. The study contributes to initiate a discussion at a conceptual and operational level for 'approach-based' disaster recovery coordination. In the author's analysis, the first three factors discussed contribute to the differences in response and recovery. However, it is these three factors that build an argument to the 'changing nature of coordination'. This is more of a result of the interplay between various stakeholders being involved over time with changing levels of engagement and with changing information needs during response and recovery. Although, respondents note the difference in nature of coordination -logistics and approaches during response and recovery respectively, there is a very unclear boundary of the gradual transition from one form to the other. Also, the study highlights that further contributions may be made by investigating into coordination by linking disaster recovery with sustainable development. The study highlights the potential for future research in identifying challenges in disaster recovery coordination.

Keywords: coordination; disaster response; recovery; tsunami; governance.

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## A modified needs assessment method in post-disaster recovery processes

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The current needs assessment strategy in the aftermath of a disaster has started to emphasize on the social and human development impacts of the disaster. The use of this methodology was accentuated only after the mid of the twentieth century. Before this, the emphasis was on measuring destruction to assets to initiate the reconstruction activities. The inclination in the assessment process has shifted from damage to loss estimation and now to the needs estimation of the victims. The need assessment covers the entire area affected by the disaster and also the sectors of economic activities that may have sustained negative or positive disaster effects. On the basis of this needs assessment, the estimation of future needs of the population is done. This practice does not involve assessment of any skills or competencies of the victims which may be further useful for their development. The post-disaster needs assessment uses the pre-disaster baseline information to compare with post-disaster conditions in order to evaluate the magnitude and scale of the disaster. Then it determines the damage to each sector by evaluating the disaster effects and impacts in the respective sector to decide the overall recovery needs. It then prioritizes the recovery needs by using a recovery strategy. A recovery strategy has clear objectives, appropriate interventions to meet priority recovery needs and also the expected outputs and overall intended outcome, and it outlines the implementation arrangements. The short-term assessment in the early and critical stage of a disaster is done to provide immediate relief whereas the detailed assessment is long term and for the recovery and development. This paper argues that another detailed baseline survey should be conducted within a year of the disaster to examine the new development pattern the community is following. The recovery and reconstruction programs try to bring back the community to the normal stage which was before the disaster. But this normal attained is a new normal which is different from the development normal had there not been any disaster. The baseline survey should be compared with the pre-disaster survey and then any further development program should be planned. This survey will also bring the number displaced population in the relocation process and population movement since the disaster. This paper attempts to study the inclusion of capability-based approach in the needs assessment process to bring about social justice in the aftermath of a disaster. It tries to bring the emphasis from the hedonic wellbeing to eudaimonic wellbeing. It argues that the attention should be on full social recovery rather than only economic growth and development.

Keywords: post-disaster recovery process; needs assessment; welfare economics.

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## A climate-resilient Dominica informed by a risk-opportunity framework

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Small Island Developing States (SIDS) are in a precarious and vulnerable place at the frontlines of climate change. Cyclones and hurricanes are occurring with increasing frequency and intensity, causing impacts that are further complicated by slow-onset issues such as sea level rise, increasing rainfall, and temperature extremes. Disaster risk management becomes uniquely challenging because as these events occur with increasing frequency and intensity, the islands face cyclical scenarios in which emergency preparedness, response, recovery phases must be managed simultaneously and within a compressed period of time. The Caribbean island nation of Dominica is a prime example of a place in such a precarious position. Having incurred massive damage to its productive sectors and housing as a result of the Category 5+ Hurricane Maria – an estimated 57% of homes were either moderately or highly damaged and 18% completely destroyed – Dominica's Prime Minister vowed that Dominica would become “the first climate resilient nation in the world.” Working alongside existing ministries involved in the current recovery, the degree to which disaster recovery and climate resilience will complement each other and how they will be managed remains to be seen. Dominica's population is modestly sized, its education levels and development are high, the government is centralized, and its populace is well aware of the realities of a changing climate and the need to adapt. All these conditions combined, it seems that now is a very apt time to be able to integrate disaster recovery and climate adaptation, while bending the narrative of SIDS from dependence and vulnerability towards leadership and strength. This paper puts forward the framework of ‘risk-opportunity’, whereby risk and opportunity are inextricable from each other, but may be used as a simple diagnostic to weigh one concept against the other. Hazard-perspectives – simple viewings of the effects of a hazard such as riverine flooding, for example, from the vantage point of specific populations such as able-bodied citizens, children, or the elderly – inform resiliency strategies, devised for – and co-created by – a variety of stakeholders to not only reduce risks and address multiple hazards, but develop social capital while activating it. Two components of social capital – bonding within existing networks of families in a neighborhood and bridging between networks of different ethnicities or in different locations – must link to “explicit, formal or institutionalized power or authority gradients in society” in order to build trust, enhance transparency, and ensure forward motion across the entire spectrum of recovery and adaptation. The risk-opportunity framework will be used to identify stakeholder concerns and suggestions regarding the early response phase, the transition into longer-term recovery phases, and to examine how an opportunity-oriented approach can help to shape recovery and climate adaptation processes through messaging and media outreach, post-disaster planning, program design, and climate-forward national policy.

Keywords: social capital, disaster recovery, post-disaster planning, climate resilience, climate adaptation.

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*Theme 3*

INVESTING IN DISASTER RISK REDUCTION  
FOR RESILIENCE

## TRACK 3A

### Heritages: risk mitigation, adaptation and assessment

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## Evaluation of the fire-spreading risk triggered by earthquake and proposal for risk-mitigation measures using existing water environment for wooden buildings in historic area of Kyoto, Japan

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More than 20% of buildings were built before WWII and most of designated cultural heritage buildings are made by wood in the case of Japanese historic city such as Kyoto City, which has 14 World Cultural Heritage listed buildings. Therefore, development of water environment for emergency fire control is indispensable to keep the safety of historic buildings from the risk of spread fire, especially after earthquakes, which can make serious damage in modern firefighting system using city water network. The aim of this paper is to evaluate the possibility of water delivery using fire engines from existing large amount of water resources such as natural rivers, open channels, ponds, swimming pools and so on. And the distribution of fire spreading risk was identified from the viewpoint of fire catchment risk and water shortage risk using GIS in case of Kamigyo ward. For evaluation of fire spreading risk, physical fire simulation system was used with detailed data of every buildings' structure and material. For evaluating the possibility of water distribution by fire engines, a detailed field investigation was conducted to check the width of roads and performance of each water resource whether each existing water resource is possible to use or not. After identification of dangerous areas with spreading risk and water shortage risk, the fact was shown that southern part of Nishi-jin area which is a part of old famous district for production of Kimono clothes was relatively dangerous because of narrow streets and long distance from possible water resources such as Horikawa river etc. The Nijyo-jo Castle as a World Cultural Heritage site and Goshyo as an imperial palace also were evaluated as risky areas. In these cases, the limited number of entrance for fire engines became the major risk, because of moat and wall. On the other hand, the southern part of Kamigyo ward was evaluated as a relatively safer area. In this case, most effective factor might be more than 6 m width of the road in which regular fire engines can go in spite of road blockage after the earthquake. Lastly, possible solutions were proposed for each case of challenged area. Keeping the safety of cultural value and human life in historic wooden cities using existing water resources should be important for continuity of culture, history and rich water environment for future generation.

**Keywords:** evaluation of fire spreading risk; disaster risk management for wooden historic city; fire water securing with existing natural water; Kyoto Japan.

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## Building resilience through flood risk reduction: the benefits of amphibious foundation retrofits to heritage structures

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Protecting heritage architecture, urban fabric and cultural landscapes from the increasing risk of flooding wrought by climate change is a challenging prospect. Successful risk reduction strategies for heritage structures require a level of cultural sensitivity that is usually lacking in conventional flood mitigation measures. Resilient approaches capable of adapting to future flood levels that are difficult to quantify in advance, especially in our current state of climate uncertainty, are sorely needed. The Buoyant Foundation Project (BFP) provides an innovative, sustainable, low-impact and low-cost flood mitigation solution that enhances community and cultural resilience in the face of climate change and flooding, with a focus on retrofits of existing housing for vulnerable populations and communities. The BFP specializes in a specific type of amphibious construction: retrofits to existing pier-and-beam structures that enable them to remain in place until the event of a flood, when they are capable of rising, floating on the surface of the water and returning to their original positions on their original foundations as the floodwaters recede. In environmentally sensitive locations, buoyant foundation retrofits offer a strategy for sitting lightly on the land and living with flooding, providing temporary elevation as needed. This strategy works in synchrony with natural cycles of flooding, allowing water to flow where it will rather than attempting to control it, while simultaneously preventing the need for repetitive repairs or rebuilding and their associated costs. Today, many older coastal, riverine, and deltaic communities are faced with increasing flood risk, often combined with sea level rise or land erosion. Until now, the options available to owners of heritage and culturally significant properties have been limited. Buoyant Foundation retrofits offer hope to under-resourced communities and provide them with a viable, low-cost adaptation alternative to fight buy-outs, tear-downs, and “displacement by climate change”. Amphibious strategies will not solve all challenges related to the increased impacts of climate change on historic and culturally significant places and properties, but will indeed offer a strong resilience-building alternative to communities with longstanding, deep-rooted relationships to place and home. This paper will provide an overview of amphibious retrofit construction and the ways in which it can be applied to the historic preservation of individual buildings or complete neighborhoods, and its benefits in comparison to alternative strategies. It will provide several case study examples, such as retrofit solutions for traditional vernacular south Louisiana “shotgun” houses in New Orleans; for heritage buildings in the town of Princeville, North Carolina, the first town established and chartered by freed slaves in the aftermath of the Civil War; for a low-income neighborhood of modest heritage houses, “Freedman’s Cottages”, in Charleston, South Carolina; and a creative and ambitious approach for amphibiating the iconic Farnsworth House, designed and constructed by architect Ludwig Mies van der Rohe in the 1950s. It will connect to larger themes of developing methods that are both innovative and practical for providing flood protection to heritage structures, using an approach that emphasizes sensitivity and adaptability to the cultural values of existing communities.

**Keywords:** cultural heritage protection; Princeville Primitive Baptist Church; Farnsworth House; amphibious architecture; climate change adaptation.

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## A global model to protect collections in case of emergency: protecting collections at Reina Sofia National Museum

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The aim of this paper is to share a comprehensive model able to manage and protect efficiently the collections of the museums in case an emergency might arise which affects the artworks. Museums of different levels – local, regional or national – are crucial for the collective memories and sociability of groups as well as they play a key role in providing a sense of community belonging. Everybody knows the capacity of cultural heritage to generate sustainable economic growth and, on the other hand, the irreparable disaster that implies the loss of this cultural heritage. With this purpose in mind, we have created and developed a management system which includes an innovative analysis and planning technology with an ensemble of means and dynamic technological methods able to store, manage, update, manipulate, recover, analyse, show and transfer special data (Geographic Information Systems, GIS) and characterisation of the collections in order to prevent and minimise the scope of vulnerabilities and obtain maximum protection, as well as to manage the whole operating process in case an emergency may arise and a contingency plan for the artworks protection needs to be deployed at Reina Sofia National Museum. This model's innovation, which includes the whole risk management cycle, lies, therefore, in the creation of an innovative and dynamic analysis methodology which will allow us to implement georeferencing technologies to the protection of artworks in case of emergency. The complexity of the model and its holistic approach required a multidisciplinary research team as the one we have created (conservators, restorers, chemist, architects, security manager), who known not only the collection but also the museum geospatial characteristics, as well as its facilities or the measures deployed by the museum in order to face anti-social acts or natural risks. Thus, we can see that the model is organised in two layers: the creation of an analysis model or methodological superstructure, and a second layer which would be the technological infrastructure. The advantage of the dynamic model proposed is that it analyses the works, spaces and social context as a whole, suggesting a global and dynamic analysis that responds to an equally global (because the building or container and the context affect the potential risk at which works can be put) and dynamic (because reality is variable) situation; that is to say, unlike the more traditional and static models where the analysis of collections and building is made separately, here we propose a holistic view where all the parameters are considered as a whole. Therefore, in the face of a complex and dynamic reality, we must also respond with an approach that takes into account that complexity and dynamism. The outcome of this model is precisely the intersection of this two layers, which will give rise to a model of joint management (methodological and technological), which materializes an application subject which is being implemented at Reina Sofia Museum, and can be able to become a reference pattern where other similar institutions may see themselves reflected.

Keywords: cultural heritage; museums; emergency; GIS; risk management.

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## Analysis of heating related energy performance of traditional timber framed buildings: the case study of Rize, Turkey

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Cultural heritage and traditional construction techniques have key importance in disaster resilience in order to cope with the local capacity. Indigenous knowledge has been kept since generations and consigned to posterity, by its adaptation to the existing environment and well behaviour against natural exposures. Usually the nature of this adaptation is very smooth including changes and transformations in daily life, natural occurrences and climate change, practices and the like within the concept of heritage as a living phenomenon. However, when this change takes place as a dramatic one such as the change of building construction technology in a massive way, density of population, infrastructure, climate change etc. coping with local capacity would not be easy and disaster risks may be increased. The aim of this study is to explore traditional timber framed buildings in general and to focus on their skin performance in order to discuss disaster resilience of indigenous technologies. Rize, located in Black Sea Region, the Northern part of Turkey, will be studied as a case study to investigate traditional timber framed buildings and their skin performance. Rize includes two particular traditional timber framed building construction techniques with masonry infill, which are called in local language as “göz dolma” and “muskalı dolma”. The timber frame of “göz dolma” is organized as squares which are infilled with a single stone while the timber frame of “muskalı dolma” includes diagonals to form rhomboids which are infilled with large pieces of stones. In terms of disaster risk mitigation and resilience practice indigenous knowledge will be explained by modern science approaches in order to increase local capacity and community involvement. The main idea to boost disaster resilience by heritage preservation is to integrate indigenous knowledge into modern social and economic life by use of natural resources in a sustainable manner. Here, the goal is to promote traditional building construction techniques and preservation of cultural heritage in national and local level aligned with Sendai Framework priorities. The expected result of this study is to discuss skin performance of traditional timber framed buildings by analysing Rize case as a resilience-related domain in order to be used in disaster resilient management plans. Additionally, adaptation of traditional techniques to the new building constructions will be dealt with in a discursive manner in order to be proposed as part of disaster resilient management plans.

**Keywords:** traditional timber framed buildings, resilience, heritage, skin performance of buildings.

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## Responding to change: adaptive re-use in Medina of Fez

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Cultural heritage might be considered as a creator of identity for the communities associated with its tangible and intangible values that shape it. Intangible values of cultural heritage give life and spirit to the tangible ones within their existing environment and context. This aspect promotes cultural heritage as a living expression and certifies its irreplaceable role to be a source of identity for communities and individuals to be protected and consigned to the posterity. Indeed, its protection includes public authorities and individual works in terms of existing safeguarding strategies and conservation approaches. Some of the actions undertaken until the present might be examined in terms of their results. Many heritage examples around the globe currently are under the risk of degradation or annihilation. Therefore, conservation and preservation actions are based on development of new strategies to protect cultural heritage, considering both tangible and intangible. In this study, one case is selected to be explored in order to examine adaptive re-use strategies as an investment in tourism sector to enhance the economic, social and cultural resilience of communities which is aligned with Priority 3 of Sendai Framework. Selected case study is Fes, a city of Morocco inscribed in UNESCO's world heritage list. The aim of this study is to examine the current state of heritage buildings in Medinas (old city) of Fes and to propose a strategy to safeguard their cultural heritage. Adaptive re-use is selected as a main strategy for houses in Medinas because of their existing condition: most of the examples are abandoned and few are restored or converted into restaurants, guest houses, exhibition galleries and the like, intended for foreign visitors located in the city as a symbol of an ancient civilization. Adaptive re-use process positively effects the social and cultural environment by maintaining heritage significance of buildings and ensures their survival. With a special focus on traditional old houses, the process of adaptive re-use is part of a move to adapt the built environment to a contemporary lifestyle. Even though adaptive re-use strategy may be a backbone for preservation of cultural heritage and ensures protection of tangible values it increases tourism industry as a key economic driver and needs to be managed thoroughly. In this sense, the way of collaboration of public and private stakeholders in order to enhance resilience and to control tourism impact is critical. Expected result of this study is to discuss adaptive re-use approach in cultural heritage preservation with its link to Sendai Framework for building resilience.

Keywords: adaptive re-use, preservation, cultural heritage, Morocco – Fes, tourism effect.

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## Fire risk in the historic city centre of Valparaíso: preliminary assessment and mitigation strategies

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The Historic Centre of city port Valparaíso, inscribed in the Word Heritage List in 2003, is affected by several natural, environmental and anthropogenic threats, which endanger the preservation of its Outstanding Universal Values (OUV). Among these threats, fires have caused great destruction in recent years, causing significant material losses, with social and economic impact on the resident community. Nowadays, the real impact of these fires on the OUV of the Site is not determined, which hinders the articulation of effective measures to reduce vulnerability. The historic area has unique characteristics that are directly related to risk fire. We refer to a complex topography, with a series of hills, densely inhabited, with narrow vehicular traffic routes, areas without vehicular access, a poorly organized community, among others. To this is added the lack of periodic maintenance of the buildings, many of these wooden constructions, and without the appropriate safety standards due to their construction date. This research evaluated the impact of fires on the architectural and urban heritage of the Historic Centre of Valparaiso, from the record of more than 150 fires occurred between 2000 and 2016. Some reports of such fires identify causes, but refer especially to the building itself. From the proposed methodology, were determined various vulnerability factors associated with the context, the characteristics of the architecture and public spaces, and the community, understood as a broad spectrum of groups linked to the management and operation of the site. This allowed complementing the analysis of the causes, proposing indicators that determine the potential risk fire. They were taken as sample two specific areas of the Historic Centre, with various architectural and urban characteristics such as materiality of buildings, vehicular access, types of uses, proximity of fire fighters, among others. The results in one of the areas indicated that the buildings with greater risk corresponded to those located in areas of difficult accessibility for firefighters: narrow streets or pedestrian passages, located on the slopes of the hills. Also the type of continuous grouping between housing facilitates the spread of flames. In the other area, the regular urban plot allows a better vehicular accessibility, however, the precarious state of conservation of the buildings increases its vulnerability. Among the factors assess that most affect vulnerability the lack of firewalls and fire detection or extinction systems is remarkable: these historic buildings were designed without safety standards. Regarding the state of conservation, obsolete electrical installations are the main source of fire ignition in many cases, added factors such as materiality, occupation and interventions. From the analysis of the data, it was estimated which were the aspects that most affected the vulnerability of the buildings and their impact on the OUV. Finally, risk scenarios were simulated, associated with vulnerability reduction proposals that could be implemented.

Keywords: word heritage, risk assessment, fire, historic centre, vulnerability.

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## Disaster risk mitigation for World Heritage city: case of Walled City of Ahmedabad in India

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In many cities across the globe and even in India, the oldest parts are those that house not only the heritage of the city but also are amongst the most densely populated parts of the city. Such parts are also frequented by visitors, sellers and purchasers of goods while housing bustling formal and informal markets. Such parts of the city, in general, do not witness the local authorities exercising urban planning tools for land development and thus remain with the same spatial design temporally sans interventions required for Disaster Risk Mitigation. The city of Ahmedabad, one of the fastest growing cities in India is inhabited by over 6 million people. The city has recently been declared as a UNESCO World Heritage City. The city limits are expanding by leaps and bounds with land being allocated for various land uses in the decadal development plans prepared by the local urban development authority. In each of the development plans the walled (old) city of Ahmedabad which is the area considered for achievement of World Heritage city status due to its outstanding universal value, has not been included (in terms of land-use planning) due to the presence of several heritage monuments in this part of the city. The oldest part of the city has land uses comprising of residential (traditional 'pol' housing), commercial, light manufacturing, institutional, religious, recreational as well as open spaces spread over an area of about 5.51 km<sup>2</sup>. In fact, this is the busiest part of the city diurnally. This part of the city is the commercial hub of the city with the major grain, fruit, meat and poultry, fabric, utensils, etc. markets and city's main railway and bus terminus located within it. With the passage of time, Ahmedabad's walled city needs to be prepared to also welcome and safeguard the interests of tourism which will witness a rise due to the recent achievement of the World Heritage City tag. Hence Disaster Risk mitigation is an important agenda to be looked into at depth in order to safeguard not only the interests of the tourists and visitors, but also that of the local population as well as floating population arriving from nearby urban and rural areas. A study conducted in the old city part of Ahmedabad for one of the 'pols' and its surrounding area revealed through use of GIS and RS techniques, household surveys, built form use and spatial arrangement of built form; that there is an imperative need to have urban planning interventions with respect to disaster risk reduction so as to safeguard the interests of the local community as well and that of people frequenting this part of the city for trade and commerce, tourism, religious and social purposes.

Keywords: heritage, disaster, urban, mitigation, risk.

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## TRACK 3B

### Investing in resilience: the economics of disaster risk reduction

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## A suite of built-environment oriented metrics for enhancing community resilience in high-density cities

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A robust, flexible, interconnected, smart and resilient built environment, including buildings and infrastructure systems, holds a prominent position in providing a liveable society with economic vitality and sustainable development. The failure of any of its subcomponents could lead to cascading catastrophes to adjacent and/or interdependent components or even the dysfunction of the whole community. It has been increasingly recognized that infrastructure resilience could help communities of various scales tackle the unprecedented challenges resulting from natural disasters, man-made threats, climate extremes and chronic stresses. Although a variety of community resilience frameworks have been proposed, they may not be utilized directly by high-density cities like Hong Kong to tackle such prevailing high-density specified concerns as congested living environment, extreme rainfall flooding, large-scale diseases outbreak and deteriorated infrastructure failures, especially during times of crisis. This paper aims to devise a suite of built environment oriented metrics for stakeholders of high-density cities to appraise and monitor community infrastructure resilience and optimize community resilience management practices. Through comprehensive desktop studies, the metrics are designed by filtering out and synergizing representative built environment relevant indicators from public literature, as well as by developing new ones to meet the urgent needs of high-density cities. Subsequently, interviews are convened for validating the proposed metrics and unveiling possible improvements. Being a conceptual framework, different metrics are grouped into a hierarchy tree with two main branches, i.e.: community infrastructure resilience metrics and community resilience management metrics. Community infrastructure resilience metrics are further categorized into technical / engineering-oriented metrics and socio-economic-environmental oriented metrics. From a technical / engineering-oriented aspect, the metrics can be studied according to the number, types and age of the assets considered. Community resilience management metrics, being categorized into strategic, tactical and operational levels respectively, focus on the organizational ability through proper operations and efficient management practices. The preliminary findings of this paper will be enriched, validated and verified through different case studies and pilots. Future work would include developing a community resilience management system to obtain, integrate and crowdsource the data required to calculate the resilience indicators.

Keywords: community resilience; built environment; metrics; high-density cities; infrastructure resilience.

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## Building disaster resilience within the hotel sector: a mixed methods study

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Building disaster resilience before a disaster can aid all types of organisations in speeding recovery post-disaster, returning to full operation sooner rather than later. For many communities the tourism sector is integral to their economic stability, therefore the ability of the hotel industry to maintain, or regain, operations is important to the economy of the local area. Furthermore, hotels play an integral role in disaster response and recovery, providing accommodations for people responding to disaster as well as local jobs. Disaster resilience can vary depending on who is being examined. Understanding what disaster resilience is for hotels and what gaps organisations may have is crucial to planning disaster resilience building strategies. The objective of this research was to define the characteristics of disaster resilience within the hotel sector and develop measures to explore strengths and gaps in resilience. Utilising a systematic literature review approach, this research developed a framework outlining capital-based predictors customized for the hotel sector. The framework considers economic, social, human, physical, natural, and cultural capital as components of disaster resilience. Within each capital, a set of predictors and measures was developed from the literature. This view of capitals combines both potential and actual resources to contribute to adaptive capacity; the ability of an organisation to withstand and recover from shocks. The framework has been explored through a mixed methods study of hotels in two areas in New Zealand (Greater Wellington and Hawke's Bay). A triangulation of exploratory quantitative survey data, qualitative interviews, and published secondary data provided insight into the status of disaster resilience for these hotels and allowed for gap analysis and recommendations for increased disaster resilience. The data includes surveys and interviews with managers and staff. The inclusion of staff input provides a new, novel, innovative look at the connections between organisational policies and procedures and staff understandings and integration of those policies. Hotels in New Zealand were found to have many resources that contribute to their overall disaster resilience. A safety culture combined with social capital stocks and human capital skills and knowledge make for a solid foundation. Gaps included a lack of all-hazard planning, need to integrate staff in the planning process, and a need to better connect with other organisations that may be assets during disasters. With a positive growth trend in New Zealand's tourism sector and a recent history of devastating earthquakes, New Zealand provides a useful test case and may show greater attention to disaster resilience building activities than other parts of the world.

Keywords: tourism; disaster; resilience; hotel; crisis.

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## The economic argument for amphibious retrofit construction

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Smart economic frameworks and policies to inform investments in resilience and disaster risk reduction are receiving increasing attention. In an era of accelerating risk, cities need expanded sets of economically viable options to reduce risk and promote adaptation. Amphibious architecture utilizes low-cost buoyant foundations to provide existing structures with the capacity to “float when it floods”, rather than suffer repetitive loss or be required to implement an approach such as permanent static elevation that may be both culturally and economically objectionable. There is a growing need for alternative approaches that can simultaneously address technical, socio-cultural, and economic issues through disaster risk reduction policies. Amphibious retrofit construction is a non-structural flood mitigation and climate change adaptation strategy that works in synchrony with a flood-prone region’s natural cycles of flooding. An amphibious foundation retains a home’s connection to the ground by resting firmly on the earth under usual circumstances, yet it allows a building to float as high as necessary when flooding occurs, with a vertical guidance system to prevent any lateral movement. Unlike houses elevated to a fixed level, amphibious houses can easily accommodate varying levels of floodwater. Amphibious construction also offers significant economic benefits when compared to permanent static elevation. Detailed cost comparisons show that amphibious retrofits on average range from 25% to 50% of the cost of permanent static elevation. Loss avoidance studies performed for amphibious retrofits in two North American locations (Louisiana and Manitoba) provided average loss avoidance ratios of 2.1 and 5.7, respectively, demonstrating the potential for high cost savings by implementing amphibious retrofits in these locations. Furthermore, whereas permanent static elevation increases a building’s exposure to wind, amphibiation does not. A collaborative study determined that elevating the mean roof height of a home from 4 m to 10 m by implementing permanent static elevation creates a 75% increase in expected annual loss due to increased wind damage. Amphibious buildings, as they remain close to the earth’s surface during windstorms, do not experience this increased exposure to wind and resulting losses. This paper will discuss the potential for measurable cost savings that accompanies the implementation of amphibious retrofit construction, by describing 1) the installation process and why it can be so inexpensive, 2) two loss avoidance studies that were performed for amphibious retrofit installations and the range of high loss avoidance ratios that resulted, and 3) analysis of the wind vulnerability of permanent static elevation and consequent increased expected annual loss, compared to amphibious retrofit construction. The need to develop integrated and well-designed policies to incentivize buoyant foundation retrofit projects is timely. Amphibious retrofits have great potential to build the resilience these vulnerable communities desperately need.

**Keywords:** Buoyant Foundation Project; disaster risk reduction; non-structural flood mitigation; benefit-cost analysis; loss avoidance study.

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## Community flood resilience across the globe: empirical analysis of measurement and dynamics

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Flood risks are increasing worldwide, driven by population and asset growth in high-risk areas as well as changing climate patterns. There is an urgent need to better understand the benefits and costs of investments into building resilience and the decision-making processes that determine them. To tackle this challenge, the Zurich Flood Resilience Alliance (ZFRA) developed a holistic approach for measuring flood resilience at the community level across the globe. The framework and associated data management tool builds on the five capitals (5Cs) of the Sustainable Livelihoods Frameworks and the four properties of a resilient system (4Rs). The 5C-4R framework consists of 88 “sources of resilience” (indicators) grouped into the five capitals, which are graded by experts. Data collected to grade the sources consists of 152 questions, which are collected by a mixed method approach of five different data collection methods. Over two years five NGOs collected baseline, endline, and outcome measures (if a flood occurred) in 118 communities in 9 countries, with more than 6,700 direct engagements of households, discussion groups and key informants. It is estimated that more than 1 million people have been positively affected by enhanced knowledge generated through the Flood Resilience Measurement Tool. Here we present the first comprehensive quantitative analysis of the extensive baseline data. Even considering the level of detail and multi-dimensional attribution of relevant resilience aspects, as well as the challenges imminent with such large-scale analyses, this analysis generates important information on baseline resilience indicators as well as undertaking enlightening comparisons between communities across the world. The paper finds common patterns which highlight implications for how community flood resilience could be enhanced. We present results from a principal component analysis for each component of five capital framework and provide deeper insight into the underlying dimensions of flood resilience measurement. In addition, a (hierarchical) cluster analysis was conducted to better understand how community characteristics interact with flood resilience indicators across the world. Finally, bivariate correlations are calculated to analyse the dynamics of the flood resilience indicators within and across the five capital framework. As a key result, this paper identifies general dynamics and inter-dependencies between flood resilience indicators, which will help to build more consistent and reliable indicators for measuring flood resilience. The results of both PCA and cluster analysis identify different community clusters in terms of baseline flood resilience grades and general community characteristics, which indicates that flood resilience has common patterns across the world. A general result is the increasing relevance of baseline studies for any decision-making process to inform policy-makers at different levels. We glean learnings about the communities from the baseline data, which will be critical when we proceed to test the post event and endline data.

Keywords: flood resilience; community level; global scale; resilience dynamics; measurement.

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## A case study for resilient urban waterfront regeneration

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This paper examines The Eddy, completed in 2017, which is a new mixed-use multifamily housing scheme in Boston, Massachusetts (USA) that exemplifies the nexus of public and private partnerships, resulting in enhanced resiliency for the individual property and its surrounding neighbourhood. It is situated in the historic neighbourhood of East Boston on low-lying, former industrial land, which has for centuries been an entryway for flood waters into the neighbourhood. During its redevelopment from an industrial storage facility into luxury rental housing, this project was seen as a lynchpin to a larger plan by the city to help mitigate climate change factors – rising sea levels, increased heat, and increased precipitation – for the entire neighbourhood by weaving it into existing and planned “hard” and “soft” infrastructure projects. This paper explores the drivers for these measures on the project and the strategies employed by the designers and the municipality, which resulted in greater sustainability, increased resiliency, social benefits for the community, and benefits to the owner. It will explore in detail how site, landscape, architecture, mechanical systems, and interior design each play a crucial role in the purported outcomes, and it will conclude through the sharing of economic metrics derived from the client relative to the performance of the building during its first year of operations, specifically regarding marketability, operational cost savings, and a return on investment for utilizing a design approach championing both resiliency and sustainability in tandem. The main goal of this paper is to illustrate how successful public and private partnerships can be leveraged to promote cooperation, applicable within any waterfront city, whereby cities can continue to grow, densify, and celebrate their places on the waterfront while promoting increased resiliency, sustainability, and public space.

Keywords: resiliency; sustainability; housing; climate change; urban planning.

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## Cost-benefit analysis applied to investment projects

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The methodologies based on Cost-Benefit Analysis (CBA) comprise methods to evaluate the net economic impact of an investment project, and can be used for a variety of interventions. The CBA is characterized by being an evaluation model that admits monetary unity as the main measure and has been predominantly used in the context of large public investments during the second half of the twentieth century. The CBA of investment projects is explicitly required by the new European Union (EU) regulations that govern the Structural Funds (SF), the Cohesion Funds (CF) and the Instrument for Structural Policies for Pre-Accession (ISPA) in the case of projects whose budgets exceed, respectively, 50, 10 and 5 million euros. Since the Member States are responsible for assessing the proposed projects, it is for the Commission to assess the quality of this assessment before approving the co-financing and determining its rate. The present paper aims to present the CBA concepts and its application to different investment projects, identifying the procedures and phases of the methodology. Its importance and potential will be highlighted for various stakeholders in the decision-making process, as well as examples of its application to the construction and / or rehabilitation of: i) school buildings; ii) architectural heritage; iii) buildings intended for tourism activities; iv) hospital buildings; v) building structures; vi) water infrastructures; vii) railway infrastructure. The preliminary conclusions of the study under development, to date, will be presented and discussed as well as future developments.

Keywords: cost-benefit analysis, decision process, investment projects.

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## Dimensions of physical resilience to disasters

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Recent analyses of disaster impacts show that a high proportion of the world's population most affected by extreme weather events is concentrated in urban centers. More people and assets are located in areas of high risk. The proportion of world population living in flood-prone river basins has increased by 114%, while those living on cyclone-exposed coastlines have grown by 192% over the past 30 years. Over half of the world's large cities, with populations ranging from 2 to 15 million, are currently located in areas highly vulnerable to seismic activity. Rapid urbanization will further increase exposure to disaster risk. As a result, cities are becoming extremely vulnerable to threats posed by natural hazards (Malalgoda et al., 2013). Increase in severe weather events and disasters have highlighted the need for cities to augment their ability to withstand the disaster risks that they may face, and to mitigate and respond to such risks in ways that minimize the impact of severe weather events and natural disasters on the social, environmental and economic infrastructure of the city. In the light of all the above, city leaders need to make significant transformative changes and investments in the resilience of their cities. At the same time, urbanisation represents a major business opportunity. More investment in infrastructure and built environment will be required over the next 40 years than has occurred over the last 4 millennia (WEF, 2012). Consequently, the construction and real estate development sectors are estimated to grow dramatically in the next 10 years (Global Construction Perspectives and Oxford Economics, 2011). One estimate projects investment in urban development to increase by 67 percent – from US\$ 7.2 trillion in 2011 to US\$ 12 trillion by 2020 (Global Construction Perspectives and Oxford economics, 2011). A total of US\$ 97.7 trillion will be spent on construction globally during the next decade and by 2020, construction will account for 13.2 percent of world GDP (Ibid.). Cities as they grow and function, need to understand the impact of disasters and the need for investment in physical resilience while identifying and developing mechanisms that can support these activities. As highlighted by Bozza et al. (2017), a resilient structure plays a critical role within the urban environment. In fact, it can enhance the resilience of the local community because of its capability to ensure essential services and emergency response and shelter for deallocated citizens. Furthermore, severe economic and human losses can be expected due to the damage to and collapse of buildings in the face of shocking events. A city's physical environment needs to be assessed and made resilient as necessary based on hazards, exposures and vulnerabilities towards extensive and intensive risk scenarios thereby allowing infrastructure systems to cope with disasters and reducing impacts of possible worst-case scenario. To be able to assess the physical environment, it would be necessary to unpack the attributes or dimensions that underpin its functioning and sustainability. These include: governance; financing; understanding of risks; urban development and design; ecosystem services; capacity – institutional and societal; preparedness and response.

Keywords: physical, financing, risk, urban development, capacity.

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## Community cooperatives as an alternative risk financing instrument for DRR and CCA in Indonesia

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While many developed economies successfully utilise existing disaster risk financing instruments, primarily through the transfer of disaster risk to the private sector, these instruments appear to be inappropriate to the needs of fast-growing, developing and middle-income countries such as Indonesia. This study is seeking to develop a more appropriate instrument for the needs of these countries. This is an account of the early phase of a study that is seeking to develop an appropriate cooperative model for disaster risk financing in fast-growing, middle-income countries. The study will focus on Indonesia as an example of a country that experiencing this strong economic growth and the associated capital and assets but is also highly exposed to natural hazards. As a consequence, the country is exposed to increasing levels of disaster risk that are unlikely to be sustainable using existing models of disaster risk financing. This paper synthesises the literature to understand the current status of disaster risk financing in developing and developed economies, and critically examines existing disaster risk financing instruments in the context of their suitability for fast-growing, middle-income countries, including their strengths and shortcomings.

Keywords: disaster risk financing, middle income countries, community cooperatives.

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## Understanding the relationship between financial capacity and disaster resiliency: a qualitative study on the residents of Oshawa, Ontario

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Over the last few decades, we have seen an increase in the frequency and severity of disasters. This has led to an increase in the number of affected people which is largely due to the magnification of existing socio-economic problems such as inequality, discrimination, entitlement, and poverty. Recent experiences- such as the 2005 Hurricane Katrina and the 2013 floods in Calgary- reveal unlike impacts of disasters on different social groups with varied social, financial, and political statuses. However, the relationship between families' financial capacities and their experience in disasters remains still unclear in developed countries. In response, this qualitative study uses a narrative approach to explore the relationship between financial capacity and disaster resilience within the City of Oshawa in Ontario, Canada, as a typical middle-scale city in developed countries. This study applies the concept of emergency preparedness as a key indicator to explain the nexus of financial capacity and resilience. The results show that while financial capacity facilitates the individuals' and families access to certain resources and increases their resiliency, several extra factors such as experience and education, both formal and informal, also influence individuals' and families' vulnerability and resiliency to disasters. These findings help community leaders to make informed decisions and increase families' overall resiliency, acknowledging- their various financial capacities. Furthermore, the findings let individuals and families evaluate their vulnerability and resilience based on their financial capacity, education and previous, allowing them to better prepare themselves for disasters in the future.

Keywords: preparedness; financial capacity; social behaviours; resiliency; Oshawa.

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## TRACK 3C

### Resilience of cultural landscapes, built and natural heritage

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## Urban image analysis based on nitrogen dioxide (NO<sub>2</sub>) as a polluting agent; case study: historical center of the city of Cuenca

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The economic development characteristic of intermediate cities like Cuenca, in Ecuador, produces high environmental pollution due to gas emissions, which, particularly in the historical center of this city, are mainly produced by the progressive growth of the number of vehicles that circulate throughout the city. Its implications have been widely debated from a public health standpoint. However, there is evidence of damage to the elements that influence urban image perception. This reality becomes even more sensitive in areas with heritage value, due to their temporality and cultural legacy, which is transmitted from generation to generation, through collective memory. In turn, this fact is further emphasized by the inadequate implementation of local, national and international regulations with regards to preservation and conservation. Consequently, damages to this type of properties generate social, cultural and economic impacts. Therefore, the objective of this research is to analyze the urban heritage image, considering NO<sub>2</sub> as the main polluting agent in the Historic Center of the city of Cuenca. For this purpose, a spatial modeling of NO<sub>2</sub> distribution was carried out using different interpolation algorithms such as Kriging, IDW, and Spline, to identify the most suitable technique that is in agreement with the spatial analysis and territorial reality. The data was obtained from the Air Quality Monitoring Network managed by the Local administrative authority. Subsequently, photographic surveys were performed and survey questions were administered in four areas of the historic center. These places were selected according to their spatial location, pollution levels, and the type of land-use in order to perform a comparative analysis. The photographic survey and the digital reconstruction of the areas to be studied allowed the identification of direct or indirect pathological damages derived from the pollution in different materials and elements. In addition, surveys were applied to the owners and/or users of the sector, who ultimately allowed to measure the perception and quality of the urban and architectural image through a qualitative spatial model. In conclusion, it is evident that the atmospheric pollution produced by NO<sub>2</sub> has an impact on the state of the materials and on the social perception of the elements that make up the urban image. Therefore, it is necessary to develop and to articulate public policies from the areas of mobility, environment, heritage, and public health, in order to promote the conservation of Cuenca's historic urban landscape.

Keywords: urban image, historical center, nitrogen dioxide, spatial distribution, Cuenca.

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## Risk and resilience: Baiame's Cave and creation landscape, NSW, Australia

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For Aboriginal people on the east coast of New South Wales (NSW), Australia, Baiame is the creator. At Baiame's Cave, located in the Upper Hunter Valley, Baiame is depicted on the rear wall of an overhanging rock shelter that overlooks a broad grassy valley. He is represented as an eagle with penetrating eyes, soaring over the land he created. The site is of immense cultural significance to the Wonnarua people and other Aboriginal people in the region and beyond. The significance of the place is recognised by statutory protection on two separate NSW heritage lists. The site is currently facing environmental and land use pressure, including coal mining and continued agricultural production, with additional pressures from increased visitation and cultural tourism. To manage the risks to the place, the Wonnarua people have built relationships with local land owners and public authorities. In seeking continued access to the cave, which is on privately owned land, they have worked with key stakeholders to identify and manage risks to the land, the cave, its artwork, its immediate landscape setting and the broader landscape over which it looks. A multidisciplinary team of specialists in cultural heritage, Aboriginal archaeology, rock art conservation and risk management, undertook on-site workshops with Wonnarua elders, local property owners and community representatives with the following aims: to identify risks to the site from both natural and human hazards (wildfire, flood, drought, vandalism, mining and wear and tear); to develop mitigation strategies to minimize the risks; and to facilitate educational opportunities for sharing Aboriginal culture and knowledge within both the local Aboriginal community and the broader Australian community. A risk management strategy was developed for Baiame Cave and its associated cultural landscape. The paper seeks to provide an understanding of the Aboriginal attachment to Baiame Cave and the land, and the cooperative approach adopted to land management to build sustainable forms of cultural and environmental resilience for heritage. The risk management strategy is essential to supporting cultural resilience, intergenerational equity and revitalization of traditional customs, beliefs and cultural practices within the Wonnarua community.

Keywords: cultural landscape; nature-culture relationship; resilience through sustainable land management; risk management; traditional knowledge.

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# How information and innovative technologies can improve risk assessment and resilience of cultural heritage against climate change damages: the STORM project and the IoT project for the Papal Basilica of Saint Francis in Assisi, Italy

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Cultural, artistic and ethnological value of historical areas is essential for the world heritage. The possibility to be visited by people must be protected for the intrinsic significance of the Cultural Heritage and for the need to provide maintenance and preserve buildings and artefacts from disasters or long-term damages. Consequently, like in any other economic activity, resilience must be assessed and improved. The resilience process applied to historical areas is different from the ordinary cases, due to the high number of constraints to be considered but, in any case, it starts with the risk profile identification of the asset. Such profile, in historical towns and areas, is defined by the unique combination of its climate, topography and physical characteristics, by the management model and the technologies available. So, creating resilience for Cultural Heritage requires the development of a series of innovative solutions, based on the driving forces (property, authorities having jurisdictions, financial actors) which must decide the intervention strategy. Applying such approach, one of the main obstacle to reach the desired level of resilience is the lack of communication and agreement protocols. Sharing data is sensitive to any resilience policy and involves investments and organisational changes. Further, in Cultural Heritage assets, a common approach to share data must be defined to improve resilience, considering the constraints imposed by safety. In the paper the Authors will describe two possible approaches to reach the final goal of a comprehensive resilience strategy based on the application of the available information technologies: (a) the EU H2020 STORM project outcomes, aimed at building an integrated platform which support the assessment, emergency management and recovery phases of Cultural Heritage sites exposed to climatic changes damages and (b) the integrated protection system of the Papal Basilica of St Francis in Assisi Italy, based on a proper Internet of Everything (IoE) system, which will improve the preservation of the compound from natural risks and from the risks related to large crowds, showing also how it is possible to integrate both projects to create an integrated and powerful framework. Both projects are based on the consideration that a systemic and multidisciplinary approach to design a resilience strategy fitted to the needs of Cultural Heritage is fundamental to reach the desired goals. Such approach is centred on the use of the most affordable information and innovative technologies available and the consequent change in the organisation of the safety and resilience management system.

Keywords: cultural heritage, resilience, climate change, innovative technologies, IoT.

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## Understanding and communicating risk to cultural heritage: the future of preserving the past

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Recent earthquakes in Mexico (2017), Italy (2016), Myanmar (2016), and Nepal (2015) have made it clear that the past isn't safe. Earthquakes, floods, landslides and fires threaten treasured heritage worldwide. After the M7.1 earthquake in Mexico, 1,847 heritage building were damaged, including 351 historic monuments, 14 museums, and 8 archaeological areas – nearly 20% of the overall economic losses. Cultural heritage is not just about monuments or traditions, but about the people who identify with the underlying culture. Understanding this, we can help reduce irreplaceable losses and manage the economic repercussions. Identification and communication of risks to tangible and intangible assets allows site managers to work to protect sites, communities to plan and prepare for likely scenarios, and policymakers to prioritize investments to manage the risks, as well as spurring action by many stakeholders. The practices of disaster risk management and the preservation of cultural heritage need, therefore, to find common ground for collaboration. Risk identification and communication for cultural heritage have proven a valuable methodology to bring together the disciplines for more effective action, so that professionals and stakeholders can (a) understand the scope of cultural heritage at risk; and (b) communicate likely impacts to inform planning and preparation. The World Bank and the Global Facility for Disaster Reduction and Recovery are collaborating with UNESCO, ICCROM, ICOMOS-ICORP, the Institute of Disaster Mitigation for Urban Cultural Heritage at Ritsumeikan University, and other institutions and experts, to promote the integration of both disciplines, enhancing the global understanding of risk over cultural heritage assets and the use of communication tools to foster community engagement. For instance, interactive activities like the Disaster Imagination Game can help communities – including neighbours, local authorities, and heritage specialists – to understand and communicate risk. This methodology, developed in Japan, brings together different stakeholders from a historic area to analyse and assess the situation, asking them to reflect on key questions related to a specific risk scenario in their cultural heritage area, and then prepare people and places to face possible disasters. Ultimately, they discuss and decide upon potential solutions to avoid or mitigate risk, along with preparedness measures and plans for emergency response. In addition to engage participants in understanding and communicating risk to cultural heritage to spur actionable preparation and prevention action, this interactive activity also helps disaster risk management practitioners in understanding the specific challenges and needs of the cultural heritage sector. This paper will present some methodologies and results from different multi-institutional activities designed to raise awareness on the growing need for disaster risk management of cultural heritage, improve the understanding of risk assessment process and communication strategies, and support a multi-disciplinary network of practitioners, experts, and development partners.

Keywords: cultural heritage; disaster risk management; risk communication; communities; sustainable development.

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## A living cultural landscape: the Farm Pond Landscape in Taoyuan, Taiwan as an example

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Farm Pond is a unique cultural and natural landscape in Taiwan, although it is often mistaken for natural creation. Farm Pond not only reflects the natural environment conditions such as hydrology, climate, topography and soil on Taoyuan plateau, but also expresses the wisdom of Hakka people and their rice culture. However, in recent years, with the rise of industrialization and urbanization, the focus of industrial development in the Taoyuan has shifted from agriculture to processing and electronics industry. The economic function of the water storage in the Farm Pond is no longer in sight. It is increasingly being abandoned or changed into shopping malls and housing. Therefore, the function of Farm Pond and the surrounding green farmlands, as well as the development of the neighboring community, are all need to be redefined. “Settlements, rice paddy fields and ponds” were the first cultural landscapes on the Taoyuan plateau. In the past, they were a kind of coexistence system, but now because of the change in economic activities, agriculture has declined, and Farm Pond lost its original meaning. This study proposes three directions that give modern “Farm Pond” a new meaning for urban functions and places. (1) The field of urban leisure: Farm Pond Ecological Park (2) The field of landscape art: Art works intervention and education promotion (3) The field of partnership community: re-linking the broken relationship between the “communities, green spaces, and ponds” breaks. It is hoped that the conclusions proposed in this study will be helpful to the future use of Farm Pond and the definition of places, and is different from the methods and strategies for the preservation of traditional cultural landscapes.

Keywords: farm pond, cultural landscape, urban leisure, partnership community.

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## From landscape character assessment to the analysis of the risk of loss of landscape values: Arga Mountain as case study

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Alongside the preservation of natural resources, disaster reduction and adaptation to climate change, landscape preservation is a commitment of European institutions and other international organizations, progressively reinforced in the last two decades. Landscape management in mountain areas of North-western Portugal is a pressing need as a result of the increased risk of loss of historical, cultural and landscape heritage associated with traditional rural communities; the difficult recover of the landscape degradation of the agro-silvo-pastoral spaces and the recognition of the reduced effectiveness of planning policies and the territorial management instruments in force. Landscape character expresses a distinct and recognizable pattern of elements that occurs consistently and systematically, that results from specific combinations between geological substrate, landforms, soils, vegetation, land use, land structure and settlement system. The assessment of cultural landscape character, translated into the cartography of cultural landscape unites, plays an important role in the analysis of the risk of loss of landscape value, as well as in landscape protection planning, considering that it: - Enables the identification of the main elements, factors and processes, both natural and cultural, that conditioned the shaping and evolution of the landscape; - Helps to understand that each landscape unit has its own dynamics and it is differently affected by demographic and socioeconomic triggers of landscape change, as well as by natural hazards; - Grounds the analysis of the functional potential of each landscape unit; - Increases the perception of the uniqueness of a given landscape mosaic by local inhabitants, decision-makers and visitants, facilitating awareness for the importance of landscape preservation policies. Taking the Arga Mountain as study-area, this work addresses the following goals:- Complete the inventory of the natural, built and cultural heritage relevant for the landscape reading; - Identify the historical moments and processes that were crucial for landscape evolution; - Characterize the landscape character and classify the landscape units of the Arga Mountain; - Enlighten the role of agro-pastoral systems in landscape shaping, which must be preserved as an eco-sociological heritage; - Identify the present driving factors and processes of landscape change that may induce the loss of landscape characteristics that are crucial for the maintenance of its character. The identification and delimitation of cultural landscape units in the Serra de Arga was based on the correlated interpretation of a set of elements that the field work demonstrated to be determinant for the organization of the landscape mosaic: altitude, slope, lithology, geomorphological units, land use, archaeological remains, historical and vernacular heritage. The spatial relationships between these elements of the landscape are analysed in geographic information system, resulting in the identification of four large units, divided into subunits. The analysis of recent landscape dynamics identified the main trends of landscape change between 1995 e 2015 and the resulting risks of loss of landscape values, related with phenomena like depopulation, agricultural abandonment, forest fires and expansion of invasive alien species.

Keywords: landscape character assessment; landscape unit; risk of loss; landscape change.

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## TRACK 3D

### Adaptation to the increasing risk of climate change

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## Effective community engagement approaches for Climate Change Adaptation and associated Disaster Risk Reduction in the Philippines

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This paper presents an ongoing project that addresses the problem of ineffective coastal community climate change adaptation (CCA) approaches in the Philippines, which also relates to disaster risk reduction management (DRRM). More succinctly, the research question was: What might comprise key aspects of effective community engagement for the Philippines to better help reduce climate change vulnerability and achieve disaster resilient coastal communities? First, community engagement approaches in the environment and CCA fields were investigated in the international literature. This activity revealed key aspects of strong (active and inclusive, or meaningful) and weak (passive and consultative) community engagement. Second, field research explored CCA and DRRM socio-cultural contexts and policy interactions between local communities and experts in typhoon disaster-ridden Sorsogon City and the Municipality of Lavezares. The investigative focus explored the status and nature of contemporary community engagement in CCA (which also related to DRRM). Following the literature review, qualitative data was collected in three stages: (i) 28 interviews with local experts – from local government agencies, NGOs, other civil society organisations, and community councils –; (ii) 12 focus group discussions with 97 coastal community representatives – from community councils, community volunteer groups, and community CCA and DRRM groups –; and (iii) direct observation of community CCA- and DRRM-related activities. The literature review results were then compared with the fieldwork results of the respondents' reflections on the effectiveness of existing local community engagement approaches for CCA and DRRM. Findings revealed that both strong and weak community engagement approaches exist in the Philippines. Respondents at both provincial and local government levels preferred the development of strong approaches. These involved capacity and capability building, open information dissemination and meaningful (inclusive dialogic) engagement with multi-stakeholders, as also found in the international literature but added to with Filipino community engagement customs and characteristics. Such features also addressed existing evidences of weak approaches reflecting negative community values and attitudes, weak political will and agenda, slow implementation of plans and processes, and insufficient budget. Hence, respondents also suggested improving government leadership and support, incorporating open information and dialogue mechanisms and positive Filipino community engagement customs and characteristics, and enhancing policy implementation, integration, and mainstreaming. Subsequently, stronger community involvement in policy making and evaluation should also involve integrated and sustained CCA and DRRM activities, capacity and capability building, knowledge, and resources; and, multi-stakeholder and sectoral partnerships. Overall, the key policy elements suggested were to mainstream CCA and DRRM policies through the integration of top-down and bottom-up approaches, which featured multi-stakeholder and sectoral engagement that emphasised communities, governments, and other sectors working together. In conclusion, prioritising strong (or effective) community engagement for CCA and DRRM appears essential to more effectively help reduce disaster and climate change vulnerabilities to achieve resilient coastal communities in the Philippines.

Keywords: climate change adaptation; community engagement; resilience; Philippines.

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## Towards successful adaptation to climate change impact: an alternative approach for adaptation evaluation using cross-scale and time dimension analysis of formal adaptation impact to vulnerability at local level

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Adaptation is locally specific and diverse across levels and actors. The cross-scale adaptation is commonly showing national or sub-national program to intervene risk and vulnerability reduction at the local level. However, various studies find that adaptation potentially causes unintended consequences. Adaptation strategy of a group can increase risk or vulnerability to other groups. Moreover, from the time-based perspective, current adaptation can cause another risk in the future particularly when it neglects long-term potential risk or when it increases the barrier to adapt to vulnerable communities. The question is how do we evaluate cross-scales and time perspective of adaptation? This paper proposes an approach to use the assessment of dynamics of vulnerability as the contribution to evaluate adaptation. IPCC highlights that implementation process of adaptation is important to monitor the success of adaptation. This paper assesses the changing of vulnerability components such as livelihood and adaptive and coping capacity at the three different times of observation namely before adaptation implemented followed by first and second condition after adaptation implemented. This paper analyzes the social, institutional, and perception issues that influence the ability to maintain and enhance capacity to adapt which will shape vulnerability at present and in the long term. This paper is based on a three-year longitudinal study in coastal Jakarta among the vulnerable groups who experiences extreme floods and currently affected by the implementation of adaptation strategy by the local and national government. There are three formal adaptation strategies that selected in this research namely dike, reservoir, and relocation. Data collection is gathered for the three years (2015-2017) which consists of two times interviews with 451 households in 2015 and 2017 combined with in-depth interviews, focus group discussions and interviews with related stakeholders at national and regional level. The data analysis uses triangulation approach combined all data resources. This study finds that different process of adaptation strategy leads to the different level of unintended consequences to the affected communities. The first-order adaptation, implemented by government potentially cause another risk and vulnerability among the affected group where they have to do the second-order adaptation. They have to adjust to the new condition caused by the adaptation to climate change impact. It causes loses some capacity to cope another risk to climate change impact in the future. In addition, lack of participation during the process has caused new uncertainty as a new risk among the communities. This study is highly relevant to the current need to develop a framework to evaluate adaptation, particularly across scale and over-time. The cross-scale approach in this study gives an important contribution to the adaptation planner in order to involve the vulnerable group as the recipient of the impact of the adaptation strategy. Ideally, the adaptation can reduce vulnerability and increase the resilience of all affected people or communities. While it is very challenging to evaluate adaptation based on an outcome of the successful to reduce vulnerability, this study proposes the dynamics of vulnerability as an approach to contribute to the adaptation evaluation.

Keywords: successful adaptation, dynamics of vulnerability, climate change impact, Jakarta.

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## Political barriers to Climate Change Adaptation in indigenous communities: a case study on the Mohawk Community of Kanesatake, Canada

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After losing faith in the effectiveness of mitigation strategies, “adaptation” emerges as a growing trend in the climate change studies. The switch from climate change mitigation to the adaptation to its impacts or effects – which may be beneficial or adverse – initially appears to be a promising strategy. Academics and practitioners, however, confront limits and barriers to adaptation both in theory and practice. Despite the extensive efforts in understanding limits and barriers, little is known about political and institutional barriers, more specifically political challenges in Indigenous communities that typically nullify the effect of adaptation strategies. This study aims at bridging this knowledge gap by investigating the experience of the Mohawk community of Kanesatake, a First Nations community in Canada, during and after the 2017 floods in southeastern Quebec. This case study draws on data collected by reviewing documents, interviewing relevant stakeholders and experts, as well as a field visit. Results reveal the links between the proximate set of barriers and historical, political pressures in Indigenous communities. Findings explain that unhealed wounds in relationships among nations generate political and institutional hurdles, which eventually orchestrate the co-occurrence of multiple barriers: the lack of land ownership rights, insurance, and social institutions such as police force and firefighters, to name a few. Findings have implications both for theory and practice. In theory, the findings reveal the fact that barriers are not mutually exclusive; in fact, they are often interdependent. In practice, findings also prove the fact that policies fail if they disregard causal interdependencies. Ultimately, the findings express the need for further studies focusing on the interdependency among barriers and exploring contextual conditions in which barriers appear, develop, and persist.

Keywords: climate change adaptation, political barriers, institutional fragmentation, indigenous community of Kanesatake, Canada.

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## Awareness relevance in cities' climate change resilience building process, a literature review

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Climate change is considered one of the 21<sup>st</sup> century's challenges. In the last decade, the effects of climate change have increased leading to higher frequency of heat waves, an increase of the sea level, more intense rainstorms and more frequent droughts. However, even if the effects of climate change have got more notorious, there is still a considerable social denial. The existing social rejection toward climate change is mainly due to cultural believes, received education, personal experience and political ideology. This social denial leads to a passive behavior when dealing with the challenge of climate change that consequently hampers the resilience building process. Therefore, there is not only a need to get prepared to face climate change but also to generate a behavior transformation. In fact, transforming behavior will conclude with a higher preparedness level to face climate change. As a consequence, local mitigation and adaptation plans have been elaborated recently to ensure the needed engagement and participation of all the relevant stakeholders. In fact, private, public and people's involvement is needed during the whole process of mitigation and adaptation. However, how to end with the existing barriers, develop cities' climate change resilience building plans and move from theory to action has not been determined yet. In fact, little research has been carried out concerning how to effectively implement the elaborated cities' climate change resilience building plans. Evidences from literature conclude that awareness composed by experience, attention and knowledge are the key elements to end with the existing barriers and successfully move from theory to action. Awareness has been stated to be of high importance not only due to its capability to enhance communities' proactivity and engagement, but also because being aware increases the mitigation and adaptation capacities and consequently minimizes the impacts of climate change. Based on this hypothesis, the aim of this paper is to develop a literature review in order to analyse the role of awareness in cities' climate change resilience building process as well as the process and effects of building awareness. To do so four research questions have been defined and a systematic literature review has been carried out to answer each of them. The answered research questions are the following: (1) What are the mechanisms that develop awareness?, (2) Which method is the most effective for developing climate change awareness?, (3) How can the relation between awareness and cities' resilience to climate change be represented?, (4) What are the consequences of developing awareness in cities' climate change resilience building process?. As a result of the systematic literature review, four main conclusions have been addressed, one for each of the research question.

Keywords: climate change; awareness; resilience; engagement; adaptation.

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## Building urban critical infrastructure resilience to climate change

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In the past decade, natural risks related to climate were the cause of the 90% of the natural disasters. Indeed, in the last years, urban areas have been seriously affected due to the high impacts caused by the extreme weather events. This fact highlights the need to adopt actions that contribute to reducing and effectively tackling the negative effects of climate change. The proper functioning of our cities and the welfare of society is based on the good performance of critical infrastructures and, in turn, these critical infrastructures are vulnerable to the effects of climate change. Climate change affects critical infrastructures in the short and in the long-term, as it modifies the weather patterns increasing the frequency and the intensity of extreme weather-related events. This fact makes the crises affecting critical infrastructures more difficult to predict and, thus, to face them. In this context, resilience is becoming a potential strategy to deal with climate change effects, because of its adaptive approach taking into account uncertainty and low probability of high impact events, as well as the long-term effects. The resilience building process requires the active involvement of all the stakeholders from the earliest stages of the process. Collaboration is crucial in the context of critical infrastructures since, in addition to external factors such as legislation or technology, the resilience level of a critical infrastructure not only depends on the critical infrastructure itself but also on the others. This paper analyses, by means of two empirical case studies in the Basque Country (Spain), how climate change affects urban critical infrastructures and thus to society. We adopted a collaborative approach through a co-creation process where four workshops were carried out with the participation of a multidisciplinary set of 30 experts from different sectors: energy, water, health, transport, first responders, environment and public administration. In these workshops, exercises to identify the effects of climate change on critical infrastructures were performed. Then, the interdependencies among critical infrastructures were analysed. Furthermore, we studied the impact of a specific critical infrastructure on society in the short and long term and finally, the direct impact of climate change on society. The process highlighted that, from critical infrastructures point of view, climate change is perceived as a physical threat that leads to physical impacts and that the magnitude of the crises is measured by the means of resources or help needed, being cooperation and coordination, including citizen's participation, imperative especially for smaller towns. The interdependencies analysis also revealed that there is a lack of understanding the interdependencies relationships among critical infrastructures and their effects in the long term. The analysis will result in a methodological guideline that aims to help cities to improve the resilience level of their critical infrastructures to climate change.

Keywords: climate change; critical infrastructures; resilience; collaborative methodologies.

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## Integrating local knowledge and scientifically generated climate information for resilience building

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Climate change is having devastating effects on our planet, at a scale exceeding representation and eluding popular imagination. It has been defined by Deschenaux as one of the greatest challenges affecting Africa today and is having significant impact on climate extremes. In fact, rural households in Burkina Faso, West Africa, are subject to the most immediate and dramatic effects of climate extremes, being affected by intense droughts and disastrous flooding. Moreover, climate change is affecting local knowledge on weather and climate that farmers have used to predict seasonal tendencies. Conversely, scientific data, generated by Meteorological Offices worldwide, is becoming increasingly able to forecast weather and climate which could increase people's resilience to climate shocks. However, many barriers exist in making this information accessible, relevant and useable for people at risk including illiteracy and lack of access to radio or smartphones as well as impacts of socio-economic background and gender differentiated access. This research, funded by NERC Innovation Placement grant, aims to identify conditions necessary for co-producing consensus forecasts which focus on equally valuing different sources of knowledge, such as local indicators and scientific knowledge. An additional facet of the project, funded by King's College London Arts in Society Innovation scheme, also aims at gathering personal testimonies and first-hand evidence of climate change from rural communities and scientists to increase public understanding of climate change in the 'Anthropocene'. These personal documents from the frontline of climate change will provide a tangible entry point into a global problem that must be comprehended in order to be tackled. What spaces, processes and mechanisms enable farming households, researchers, traditional forecasters, agricultural extension workers and meteorologists to change the way they perceive and value each other's knowledge on seasonal forecasts? This paper takes on a novel and multi-disciplinary approach combining climate and social sciences with visual art in a process of co-production of knowledge between people at risk, researchers and artists to create a disruption in how stakeholders acknowledge and analyse forecasts and in how a wider audience understands the consequences of climate change. Data from Burkina Faso shows a vast, localised and contextual knowledge of animal behaviour, tree and fruit production, moon stars combined with ceremonies and sacrifices, a knowledge people base their decision-making on. On the other side, scientific information is perceived as being too global and not enough downscaled to be trusted. New methods such as Council and Theatre of the Oppressed offer an interesting platform for scientists, researchers and people at risk of climate extremes to tackle the issue in a novel way. In fact, co-produced consensus forecasts, we argue, equally valuing all sources of knowledge, would lead to greater uptake of scientific climate information which, in turn, would improve people's resilience to climate extremes.

Keywords: climate change; climate information; climate services; local knowledge; co-production of knowledge.

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## Assessing contribution of Climate Change Adaptation measures to build resilience in urban areas: application to Lisbon

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Urban areas are dynamic, complex and vulnerable systems involving multiple strategic urban services such as water supply, wastewater, stormwater and waste management, energy supply, public lighting, transport, public security and stakeholders. Climate stresses and shocks affecting the urban water cycle, such as heavy rains, tide effect or droughts, can produce direct impacts on the above strategic services and cause cascading impacts on them with serious consequences for people, natural and built environment and economy. Potential effects of climate dynamics on the urban areas involve aggravation of existing conditions as well as the occurrence of new hazards or risk factors. Challenges generated by climate change in these areas, expected until 2100, require an integrated and sustainable approach to increase resilience. The project “RESilience to cope with Climate Change in Urban arEas – a multisectorial approach focusing on water” aims to assess current and future resilience, related to climate change scenarios, through a multisectorial approach with focus on water and to support cities to become more resilient, contributing to co-build their resilience action plans. The paper presents a resilience assessment approach applied to the Lisbon Municipality. This approach is objective driven considering four resilience dimensions: organizational, governance relations top/down; spatial, urban space and environment; functional directed to strategic services and physical to assets/infrastructures. It is presented the functional and physical resilience dimensions applied to waste and transport sectors in Lisbon. The waste sector assessment showed that the low exposure and vulnerability, together with resilient measures already in place, contribute to achieve the resilience objectives, namely regarding climate change exposure, preparedness, and recovery and build back. For mobility sector, particularly regarding identification of infrastructure critical assets, it was identified the need to consider other services infrastructures that highly depend on mobility infrastructures. This is the case of stormwater, since the impact on hydrological processes is significant. It was also identified the need to extend the existing flood and tide hazard maps and data on risk to other hazards. Results of application to Lisbon allowed diagnosing these city sectors, regarding services and infrastructure, and identification of improvement opportunities. This will support the selection of measures and definition of strategies to build resilience. All this approach combined with the priorities of Sendai Framework for Disaster Risk Reduction (2015-2030), the Paris Agreement on Climate Change, the Strategic Development Goals and the 2030 Agenda highlight the relevance of the mission of Lisbon to reduce risks and become resilient.

**Keywords:** adaptation measures; climate change; disaster risk reduction; multisector approach; urban resilience assessment.

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## TRACK 3E

### Preventing natural hazards from turning into natural disasters

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## Linking physical vulnerability to the resilience of the built environment

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The magnitude and frequency of torrential processes (flash floods, hyper concentrated flow, debris flows etc.) as well as the spatial extend of their consequences in mountain areas are expected to change in the future due to climate change. However, the consequences of future events are also related to the characteristics of the built environment and the vulnerability of the elements at risk. Focusing on vulnerability and resilience could be the key to disaster risk reduction. Vulnerability and resilience are two complementary concepts, however, the resilience of the built environment has not been adequately investigated until now. There are many definitions of resilience in the literature, some of them focusing on ecological or social systems and some on physical systems supported often by frameworks (e.g. the adaptive cycle model). Focusing on the interaction of the built environment with natural hazards and without attempting to introduce one more definition for the term, we suggest that resilience of the built environment is strongly related to the robustness of a system and its capability to respond to a shock. However, it is also relevant to its capability to return to its initial condition. Vulnerability of the built environment, on the other hand, is often defined as the degree of loss and is assessed by so-called vulnerability curves that express the relationship between the intensity of a process and the correspondent loss. We present here a physical vulnerability index for buildings susceptible to torrential processes. The index is based on a selection of indicators related to those characteristics of the buildings and their surroundings that contribute to their vulnerability and lead to negative consequences for the local community. The study makes a step further and investigates the interaction between vulnerability and resilience of the built environment in two ways: (a) by using the index to evaluate resilience related to the reconstruction phase (build back better) and (b) by proposing indicators related to the resilience of the built environment to be included within the original physical vulnerability index. The concept of the resilience of the built environment is revisited and the interactions between resilience and vulnerability are investigated and highlighted by examples from the Austrian Alps.

Keywords: vulnerability index; torrential hazards; indicators; disaster risk reduction.

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## Autonomous action on urban flood risk by school stakeholders in Dong Hoi, Vietnam

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Coastal communities in Central Vietnam face significant disaster risk due to the occurrence of natural hazards combined with the social vulnerability of societies and risk multipliers like rapid urbanisation and climate change. Floods hazards are the most serious and destructive threat to the education sector in this disaster-prone area. School must find a way to continue in the provision of education despite the disadvantages faced and with or without appropriate levels of government support. A regional research project on educational continuity in urban flooding events was commissioned by Save the Children, gathering data from school stakeholders in Bangladesh, Thailand and Vietnam. The primary objective was to provide practical recommendations for school educational continuity in South and Southeast Asia. This paper will analyse the critical aspects of the autonomous participation of local school stakeholders in response to urban flood risk, utilising the data gathered in Dong Hoi, Vietnam. Qualitative research methods were employed in conjunction with multi-stakeholder involvement. The data represents one primary school, one lower secondary and one upper secondary. Semi-structured interviews and focus group discussions were used to capture a range of rich, descriptive and detailed data required for thematic analysis of collected data. Findings show that a top-down national disaster risk management system has not mitigated the community's (or school's) vulnerability or its ability to respond to serious flooding events. Policy frameworks and disaster risk management strategies developed at the national level have not carried into local practices, putting pressure on local community initiatives that suffer from a lack of resources and limited mechanisms of governance. Community stakeholders are often marginalised due to their lack of resources to protect themselves. However, they respond with autonomous action to protect themselves. The study has shown that high-level planning remains vague and indeterminate for most of the school communities – limited training is provided to teachers, students and other stakeholders about their roles and duty in flood response action plans. Participants in the study possess significant capacities that can be mobilised for disaster preparedness, response and recovery; but these capacities must be recognised and valued. The evidence from Dong Hoi indicates that a community-based approach would reduce disaster risk in the education sector and we make recommendations to frame a meaningful debate on the policy and practice implications that emerge.

Keywords: Vietnam; urban flooding; capacities; participation; schools.

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## Towards sustainable fishery: building back better fishing communities after the Great East Japan Earthquake 2011

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The Great East Japan Earthquake in March 2011 caused severe damage to one third of the fishing communities located along the Pacific Ocean of the Tohoku coastal area. The Tohoku Ecosystem Associated Marine Science (TEAMS) project was launched in 2012 to track and monitor the changes of coastal marine ecosystems, and to deliver science-based information relating to fishing grounds and coastal marine environment to local fishing cooperatives and the member fishermen. The objective of this project is to monitor and disseminate scientific findings pertaining to changes in marine ecosystems after the earthquake and tsunami so that fishing communities are informed of the impacts and recovery of coastal marine environment. One sample site observed damage and disappearance of seagrass and seaweed beds, however after a certain period of time showed signs of recovery. Fishery is entirely dependent on marine resources, and coastal marine ecosystem and environment provide important habitat for marine animals. To find how local fishermen and fishing communities have responded to earthquake and tsunami, interviews were conducted in multiple sample bays. Findings from fieldwork involving in-depth interviews and participant observations can be summarized as follows, a) fishermen were aware of the environmental pressure in which overcrowding of aquaculture rafts in the bay cause negative impact to growth of aqua-farming species like oyster, b) after the earthquake and tsunami, local fishermen became aware of the marine environmental capacity in which the bay can hold and opted for sustainable aquaculture, c) as an action plan to achieve sustainable and resilient fishery, oyster farming community in Togura of Shizugawa bay has decided to apply for marine-ecolabel, commonly known as the Aquaculture Stewardship Council (ASC). The results from fieldwork suggest the need for a comprehensive marine ecosystem habitat map so the fishermen are informed not only about marine environment in which they live in, but to understand the cycle of marine ecosystem that serve as a basis of their livelihood. Another implication from the findings suggests the necessity to design, develop, and implement sustainable fishing plan between the local fishermen cooperatives and the local government. The establishment of sustainable fishing plan enables fishermen to make decision based on scientific evidence, and enhances marine resource management so marine commons can be passed on to future generations. The main conclusion reached from the findings was the importance of disaster risk management and sustainable development of coastal marine ecosystems in building fishing communities back better, by disseminating science-based findings obtained through monitoring of marine ecosystem.

Keywords: Great East Japan Earthquake and Tsunami; coastal ecosystem; sustainable fishing; habitat mapping; building fishing communities back better.

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# An innovative strategy to increase the resilience of flood-vulnerable communities while reducing risk of population displacement and psychological trauma

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Protecting communities from “natural” disasters, the displacement and psychological trauma that accompany them, is a challenging prospect. Vulnerable communities are faced with responding to increasing climate change-induced crises and adapting to a dramatically changing environment, having only a limited set of tools that are largely inadequate to cope with the intensity and urgency of the impacts. Today’s and tomorrow’s increased frequency of natural hazardous events requires forward-looking and creative strategies to limit the likelihood that hazards such as heavy rains or intense storms will evolve into disasters, impacting communities and their housing and causing repetitive loss and the need to rebuild. To date, standard flood mitigation strategies have relied heavily on systems that either attempt to control and redirect water (e.g. levees, dams, sea walls) or to try to avoid it (e.g. buy-outs, land-use restrictions, permanent static elevation). How might we, instead, embrace Mother Nature, adapting ourselves to new ways of appreciating the presence of water, and our buildings to new ways of accommodating flooding, without significant damage to the built environment or human psyche, or objectionable changes to customary ways of life? Amphibious, or buoyant, foundations are one answer. They provide a cost-effective, adaptive flood risk reduction strategy that works in synchrony with a flood-prone region’s natural cycles of flooding, rather than attempting to control them. A buoyant foundation is a retrofit to an existing building that enables it to remain in place until flooding occurs, when it rises and floats on the water’s surface until it returns to its original position as the floodwater recedes. Although this is a solution that is not universally suitable for all types of flooding or construction, it is nonetheless a damage-preventive strategy that in appropriate situations has much to offer to communities in crisis that have few if any other low-cost, low-impact, culturally acceptable options that create minimal disruption to daily life. Amphibious retrofit construction can be applied to individual buildings or neighborhoods, and provides numerous potential benefits in comparison to alternative strategies. This paper will highlight two case studies. Amphibious construction along the Malacatoya River in Nicaragua, which is under continuous threat of flooding, has been proposed as an alternative solution to alleviate the forced relocation of indigenous communities by the Nicaraguan government. An amphibious approach would allow residents to remain in their homes safely, without the devastation of repetitive damage or the trauma of forced removal from their homelands. A second case study is a project that has recently completed construction in the Mekong Delta in Vietnam. The goal is to implement amphibious retrofits to housing to increase community resilience and improve financial and psychological stability by reducing property damage and the need for relocation, now that annual flooding is becoming more severe due to climate change and upriver dam construction. It connects to larger themes of developing strategies for community resilience that are innovative, feasible and economical while preventing the negative impacts of forced displacement and psychological trauma.

**Keywords:** amphibious construction; flood risk reduction; climate change adaptation; population displacement; forced relocation.

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## Sustainable Development Goals: how to use the 17 measures into the territory with quality and creativity

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Worldwide emergency measures for disasters action are an integral part even into the initial master planning proposals. The demolition work is as well an important step that frequently is not integrated into a plan and, is usually forgotten in planning and it is not inserted into architecture projects. Demolitions can act into climate change and materials need to be recycle under their processes. The UN launched the Sustainable Development Goals (SDGs) in September of 2015, where they want to organize actions into 17 different areas. This organisation can be a base for future interventions even at a micro level. The World Health Organisation is promoting ‘healthy lives, for all for all ages’ and they are spreading this message around the world. Nowadays, these concerns must be attached to any proposal and, particularly into Climate Smart Cities, whether in the occurrence of an earthquake, a storm, a large fire or another catastrophic event. The research emphasises possible hypotheses that accompanied a proposal using a method type. Climate Smart Cities can use clearly a group of first seven measures to initiate a strategic plan, but the complete implementation will connect all 17 measures. These seven goals will be the number 3, 6, 7, 11, 12, 13 and 15. To create resilience into a proposal the knowledge about SDGs needs to be an integrated part of an academic level and the non-academic level.

Keywords: resilience; SDGs; climate smart cities; UN; architecture.

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## Enhancing resilience of a critical road axis in Mexico

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The failure of a bridge, whatever the cause, has high direct and indirect costs to society. The majority of failures on bridges in Mexico are due to the effect of scour. Out of the 15 major longitudinal and transversal road corridors of the country, 6 “run” along the coasts of the Gulf of Mexico and the Pacific Ocean in areas of high influence of tropical storms and extreme precipitation events. This paper presents the first results of a project aimed to develop tools and methodologies for implementing strategies to enhance resilience of road infrastructure to tropical storms and hurricanes. The main goal of the paper is to describe a strategy to assess the vulnerability of a road coastal axis under tropical storms and hurricanes. A general methodology is presented which was designed by the Institute of Engineering of the National University of Mexico. This methodology comprises several tasks: identification and location of a bridge structure; assessment of its real structural conditions by means of a visual inspection and records from the national bridge management system; probability based classification of risk using meteorological information; evaluation of soil and substructure types; and development of mathematical models of bridges with major risk. Finally, a preliminary evaluation of capabilities to recuperate in a suitable manner the functionality of the most vulnerable identified bridges, in order to decrease economic losses and prevent future failures is presented.

Keywords: bridge resilience; scour effects; infrastructure resilience.

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## Development of a physical services index for flooding hazards in built environments: the case of Metro Manila

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Most hazard assessments focus on the magnitude and probability of occurrence of trigger events, such as rainfall and tropical cyclones. While useful, they overlook the role of the natural and built environment in shaping how hazards are manifested, particularly in modifying the magnitude and frequency of the hazard and in amplifying trigger events. As an example, the overall hazard magnitude resulting from an extreme rainfall event will likely be different if it occurs in a heavily built area with waterways that are clogged with solid waste and contaminated with human waste as opposed to an area with more permeable surfaces and functioning sewers and storm drains. Aside from potentially higher flood volumes, inadequate solid waste collection and wastewater treatment can also lead to contamination of floodwater, creating human health hazards. Combined with the vulnerabilities of exposed populations and assets, this confluence of hazards may result in potentially more disaster losses than the primary triggering event would have caused. This paper developed a physical services index based on an integrated flood hazard framework that recognizes the dual role of physical urban services in the amplification and cascade of flooding hazards and as an indicator of pre-existing development gaps, which are hazards in themselves. The physical services index has 6 components, namely: urban growth, water balance, water accessibility, sanitation and sewerage, municipal solid waste, pollution loading and water quality. It was converted into a system dynamics model to map hazard relations and was parameterized using the conditions of Metro Manila, a megacity with inadequate urban services and subject to persistent flooding. The index, through the model, is a useful tool for policy evaluation. It can be used to trace and assess the effects of different scenarios on hazard processes and hazard levels. It can likewise be used to identify trade-offs and solutions that are robust and offer multiple benefits. As an approach for understanding and addressing flood hazards, it also expands the notion of what constitutes as flooding hazards which promotes resilience thinking and broadens the horizon of responses to address not just acute shocks but also chronic stresses. For Metro Manila, the effects on physical services index under urban development scenarios were explored. Results show that under conditions of strict groundwater regulation and proportional growth of waste management services with the population, the effects of population on index levels can be tempered by less physical urbanization. Conversely, if population growth ceases, the gains in the index values due to demand reduction is outweighed if physical urbanization continues to increase. Suboptimal index values, even under the most conservative scenario of zero increases in population and built-up surfaces, also indicates that measures to limit flood volume, such as flood control infrastructure and land-use planning to limit the expansion of built surfaces will no longer suffice. Large deficits in urban services also need to be addressed to prevent the cascade of flooding hazards and to improve health outcomes and well-being. Measures that reduce flood volume while improving urban services offer the greatest potential.

Keywords: physical services; hazard index; built environment; flooding; systems thinking

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## Seismic vulnerability and risk assessment of Gangtok Region, India

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About 59% of India's land is prone to moderate to severe earthquakes ( $M > 5$ ), which makes it one of highest seismic risk prone areas in the world. Destructive earthquakes ( $M > 6.5$ ), which are highly unpredictable, don't occur frequently, which makes people and local authorities ignore the importance of the earthquake resistant building design, disaster preparedness and post-disaster management. The damage scenarios can act as the base for preparation of disaster management plans, taking mitigation measures and prepare population living in the high vulnerable areas. The research used HAZUS methodology is used for assessing vulnerability and damage caused by the 18<sup>th</sup> September 2011 earthquake at Gangtok (68 km from the epicentre), which is the capital city of state of Sikkim, a major hub for tourism and economy. The scale and the details of the results are directly based on the amount of information used in the execution of methodology, using such parameters as magnitude and type of earthquake, distance from epicentre to the study area, geology and local conditions of soil, and building characteristics for the vulnerability and damage assessment. Damage reported by the local authorities was used as the reference to validate the generated results and discuss the applicability of the method in Indian context. Based on the terrain conditions, the possible hazard-prone zones and the elements at risk, a risk map was also generated. The results showed that concrete types of buildings were highly vulnerable and there is a high probability of damage to such buildings. These scenarios were matched with the reported damage. The research concludes that the HAZUS methodology can be used in Indian condition as HAZUS building types have some similarity with Indian building types.

Keywords: earthquake; vulnerability assessment; risk assessment; HAZUS; structural vulnerability.

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## Learning from less-advantaged communities how to cope with natural disasters

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This paper poses the question as to why communities with few resources at their disposal often seem better able to cope with natural disasters than developed communities. The paper highlights the strategies for dealing with natural hazards found in developed countries, particularly concentrating on the recent floods in Europe that are shown to have been produced by climate change, and the prevention and avoidance methods proposed in the face of future flooding. Using a case study approach the paper seeks ways of adapting to extreme weather conditions. It begins by looking at western methods of flood control, in particular in the Netherlands and the UK and then compares these with methods used by communities in the Pacific and Asia. Two case studies, one from the Pacific Islands and one from South Asia are used to identify how vernacular communities have adapted through organic processes to natural hazards. The paper discusses the resilience of these communities and the attitudes that have enabled them to utilise traditional knowledge to develop vernacular strategies for dealing with natural hazards. Their organically evolving adaptive strategies for hazard prevention differ from the westernised approaches of containment and control through engineering systems. Research findings demonstrate that adaptation and learning to live with flooding rather than avoidance or control is the future. Additionally, past westernised attempts to control flooding have proved to be costly failures in most instances and recent large scale engineering endeavours that often emulate historic practices only provide short term respite and at huge environmental costs. The resilience of the poor Asia-Pacific communities and the sustainability of the vernacular systems they have devised is a direct outcome of their attitudes to natural hazards and is admirable not only for the ecological sensitivity of their strategies but also for the creativity they offer if we take the time to investigate their potential for future solutions. Given climate change is leading to more severe weather events and more flooding it is now urgent that developed societies devise more fluid geographical approaches to living with water. The paper concludes by speculating on how the approaches used by communities with few resources and the strategies they have developed for increasing resilience to future disasters could be applied to the European context, given climate change is leading to more severe flooding and in 50 years living with regular flooding may be more common place.

Keywords: natural hazards; vernacular systems; traditional practices; adaptive approaches; disaster resilience.

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## Multicriteria risk assessment-based evacuation management

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Modern society is exposed both to the ‘ancient threat’ of natural disaster and artificial ones related to human activities. The phenomenon of urbanization has contributed to the increase of cities population and, consequently, to the dangerous increase of its density. Unfortunately, such phenomenon has brought with it a greater impact on citizens, private and public assets upon the occurrence of a catastrophe. Only after a high price paid, in terms of loss of human lives due to human error and inefficacy plans, society has realized the need to improve emergency procedures introducing new solutions and innovative instruments. In the event of smoke fires, bomb alarms, toxic gas leaks and even earthquake, the main objectives are two: a) ensure that, people inside the building, are alerted of the possible danger before it threatens their safety and b) help them to reach safe places in the shortest time. Scientific community is actually attracted by the problem of the Emergency Management, and the research has already started to exploit the new Computer and Automation technologies involved into the Smart Cities ecosystems that are rapidly growing worldwide. In this work, authors try to understand how is possible to improve the four core phases of the Emergency Management activities as well as Mitigation, Preparedness, Response and Recovery. By identifying potential emergency scenarios, and involving regulations referred both to the human behaviour and to the safety standards on infrastructure construction, it is possible to define some guidelines to design an effective Decision Support System. Such Decision Support System, thanks to a Dynamic Real-Time Risk Assessment, is able to process heterogeneous data, come from different sources, and to carry out an active support for the buildings evacuation procedures. The main aim of the proposed work is to supply, through an information system, an in-depth knowledge regarding the events in progress and possible impacts on the considered building. Producing an automated response means to speed up the evacuation process immediately following the catastrophic event. Indeed, deciding what are the best actions to be taken immediately after the crisis is necessary to reduce cascading effects, when an emergency occurs. Clearly, making the best decisions is crucial to achieve mitigation and an optimal emergency management. The architecture proposed in this paper consists of a hybrid approach based on techniques and models of operational research and management engineering. In particular, the proposed solution is modular and involves the cascade integration of two main elements: a) CISIApro, based on MHR model, is critical to the risk prediction and to enhancement potential damage that may affect the infrastructure; b) Expert system, based on multicriteria optimization algorithms, elaborates the suggestion on the evacuation paths according to the detected emergencies and their development. The resolution strategy has been tested on a wide range of multi-emergency scenarios and has demonstrated its effectiveness in supporting evacuation processes. Through such approach, authors implement a smart decision-making system able to provide the optimal evacuation routes from each considered infrastructure sector after the onset of a catastrophic event.

Keywords: emergency management; smart cities; decision support system; risk assessment; buildings resilience.

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## TRACK 3F

New directions in resilient infrastructure: critical, decentralized, and  
hybrid systems built to serve people

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## Comparative study of infrastructure resilience policies and practices for bay areas

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Infrastructures provide a large number of fundamental and necessary systems, facilities and services that underpin the prosperity, sustainable and balanced development of a country, region, city and other areas and communities. Recent studies have defined the concept of infrastructure resilience as an ability of an infrastructure system to cope with, resist, absorb, recover from or adapt to unanticipated disruptions. The four well-known bay areas in the world – San Francisco, New York, Tokyo and the Guangdong-Hong Kong-Macau bay areas – have already implemented a variety of policies and practices focusing on regional infrastructure resilience within city clusters respectively. However, there are only a few comparative studies about the common grounds and differences among them. This paper aims to compare different policies and practices presented by four well-known bay areas in the world in order to identify gaps and common grounds between the Guangdong-Hong Kong-Macau bay area and the other three ones. Comparative case studies are conducted on the four bay areas to obtain a holistic understanding of the infrastructure resilience policies and strategies the areas have adopted to tackle their common natural and man-made hazards. First, the concepts of regional infrastructure resilience and city cluster, as well as the basic information of the four bay areas are summarized and introduced. Second, their infrastructure resilience policies and implemented measures are reviewed irrespectively for tackling increased flooding, sea level rise and their influence on infrastructure lifeline systems including transportation through the region, water network, and pipeline system. Finally, common ground, differences and gaps of infrastructure resilience among the four bay areas are analyzed from the following points of view: policies, research metrics, research framework, implemented measures and future development direction. Through comparative case studies, there are some preliminary results of the four bay areas' regional infrastructure resilience policies, initiatives and practices. In the meanwhile, it identifies the challenges and research gaps compared with the other three ones that Guangdong-Hong Kong-Macau Greater Bay Area is facing as a newly founded bay area in terms of enhancing regional resilience.

**Keywords:** regional infrastructure resilience; bay areas; city cluster; comparative case study; infrastructure systems.

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## Critical infrastructure resilience: the critical role of “the population”

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Critical infrastructures (CIs) such as energy, communication, transport, health, water, and food are indispensable for the well-functioning of economies and societies around the world. Disruptions due to natural hazards or other adverse events can have disastrous and cascading consequences, especially if the preparedness as well as coping and adaptive capacities of the socio-technical system of critical infrastructures are low. In the face of global environmental change, likely to trigger natural hazards, cyber and terrorist attacks, as well as dynamic developments of social vulnerabilities, CI resilience has become paradigm of many national strategies. On a global scale improving the resilience of CIs has become an important goal of agreements of the Post-2015-Agenda such as the Sustainable Development Goals or the Sendai Framework for Disaster Risk Reduction. While CI resilience is often approached with a rather technical perspective, particularly from both, governments and CI providers, this contribution will showcase that “the population” – including its heterogeneity and dynamics – plays a key role in increasing the resilience of these systems, which so far has rather been a blind spot. Based on a large-scale household survey conducted in the area of Cologne, Germany in the frame of a research project funded by the German Ministry of Research and Education, this presentation will highlight to what extent different socio-economic groups (e.g. differentiated by age, income, household size, place of residence) in Germany are aware of the risk of CI disruptions, how well they are prepared for long-term outages, and who they perceive as responsible for the emergency response in case of a disruption. Results show major gaps in the preparation to outages within certain groups of the population. Moreover, the survey reveals differing expectations regarding the provision of emergency response that diverge from planned capacities. All in all, the findings stress the importance of including the population as a diverse group of actors into an integrated CI risk management. Hence, the presentation calls for a paradigm shift to adopt a more holistic, socio-technical perspective on CI, aiming at increasing the overall resilience of these systems. Despite the fact that the study was conducted in a developed country with a high level of CI protection, results may still have global implications and contribute to the Post-2015-Agenda as well as to scientific and practical discourses of CI resilience. Drawing on the findings it can be argued that it is highly recommendable to consider heterogeneous needs of the population when developing integrated risk management plans and minimum supply concepts. Moreover, the results highlight the importance of all stakeholders’ awareness of potential CI failures. With increasing expansion and reliability of CIs in developing countries also dependency might grow while individual preparedness to outages might get less, thus research findings and its implications have a high potential to be translated to other cultural and economic settings in order to increase the overall resilience of socio-technical systems.

Keywords: socio-technical resilience; critical infrastructures; disaster risk reduction; integrated risk management; end user perspective.

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## Risk sensitive land use planning for resilient urban building infrastructure: a study in Dhaka City

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Dhaka, the Capital City of Bangladesh, with an area of around 1,500 km<sup>2</sup> currently hosts nearly 18 million people and has already experienced unplanned and haphazard development through phenomenal spatial growth in the last few decades. As a result, a significant part of the city's building infrastructure is at high risk since most of them have been constructed through landfilling on the wetlands. The present paper, based on primary (site response analysis, SWOC analysis, key informant interviews etc.) and secondary data, focus on developing a risk sensitive land use planning given the occurrence of earthquake such as amplification and liquefaction. An earthquake potential map and an earthquake micro-zonation map have been prepared focusing on ground response analysis in Dhaka City. However, the study identified several factors (e.g. low public interest in natural hazards, lack of political will, deficiencies in management capacity, lack of budgetary allocations for proactive measures, emphasis on relief and reconstruction activities, weak link between existing laws governing DRR etc.), which are the major barriers for ensuring risk sensitive land use planning in Dhaka City. The study also reveals that in order to establish a resilient urban building infrastructure in the city of Dhaka, risk sensitive land use planning has to be ensured.

Keywords: risk sensitive land-use planning; resilient building infrastructure; earthquake disaster risk reduction; Dhaka City.

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## Integrating housing as critical infrastructure in urban agendas

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Housing, particularly affordable housing, is not often viewed as a de facto critical infrastructure in urban agendas. However, housing is a public interest issue and bears special characteristics, which reflect on its criticality. Considering housing as a piece of public infrastructure, is complicated by the fact that a house itself is fundamentally considered to be for private use, and often an entirely private asset. However, housing is more than just the house and when considered in this light comprises aspects of both “soft” (e.g. social connection) and “hard” infrastructure (e.g. water and sanitation networks). Here the challenge is conceptual, yet an understanding of the ways in which soft and hard infrastructures converge within housing, and houses themselves, has significant potential to influence the shift of public policies toward community-driven approaches. We posit that dialogues on resilience offer an opportunity to reposition housing as a critical infrastructure in policy discourses and urban strategies. Through the lens of resilience, housing can be framed as a critical asset, a public interest issue, and a risk for cities that needs to be accounted for. Additionally, housing is a powerful tool for the reduction of social and economic vulnerability. This approach positions housing as a fully-fledged component in resilient strategies and, by extension, as critical infrastructure. In demonstrating the opportunity that resilience frameworks present for housing and its framing as critical infrastructure, we will adopt the following premises: 1) Housing as a sector, and as a field in urban development, addresses more than the physical house, it is a fundamental component of community building and city shaping. 2) Housing sits at the core of urban functionality, linking physical, social, and economic elements. 3) Housing is not typically considered a part of infrastructure in urban development and planning. 4) Recently, disaster recovery and urban risk management policies have started to acknowledge the physical house as vital infrastructure. 5) This had led to an increased focus on the resilience of the physical aspect of housing, which is a positive step forward but has to go further. Therefore, since housing links many of the urban systems and elements which are understood to be critical for resilience and counter vulnerability, city resilience strategies should acknowledge housing as a critical and long-term process. Our analysis considers several commonly accepted resilience frameworks and assesses their capacity to support housing as a critical component of resilience planning, and unlock funding for housing as a part of resilience initiatives. We also identify and elaborate on how housing provides a critical foundation for many of the components of these frameworks through case studies and examples. In showing how resilience is a relevant conceptual framework for the integration of housing as critical infrastructure in urban agendas, we demonstrate an approach to policy making and program design that has the potential to transform cities, making them stronger, more adaptable, and capable of recovering from sudden changes in their physical, social, and economic environments.

Keywords: critical infrastructure; housing; urban agenda; communities.

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## Bermanism: building reflexive practice into resilient infrastructure planning

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Traditional resilience infrastructure planning operates under the fundamental premise that rising tides are a threat to our homes, our cities, and our way of life. Thus, the role of infrastructure is to protect: to use hard and soft-scaping to minimize risk while maximizing the amount of land or assets that can be saved. This framework proposes a new direction in resilient infrastructure planning which provides an opportunity to engage in a process of “problem-setting” rather than “problem-solving.” Problem setting forces us to ask the critical questions of “resilient infrastructure for whom?” and “resilient infrastructure for what?”, rather than resort to quick fixes to maximize protection. In an era where it is impossible to defend every inch of our coasts, infrastructure projects provide practitioners the opportunity to set priorities that can transform existing destructive environmental and social practices. To examine the role of transformative infrastructure, we proposed an intervention in Chelsea, MA, an industrial coastal town near Boston in which low-lying industrial functions retain priority access to the waterfront and are most vulnerable to the impacts of sea level rise. In this area, we asked, what in Chelsea should be protected, and what should be released back to the sea? How could a new type of resilient infrastructure help build a higher quality of life for residents? To begin, we examined existing assets in and connected to Chelsea including transportation networks, employment centers, and housing stock. We then identified sources of risk and vulnerability, both in terms of exposure to pollution as well as existing and future exposure to coastal and pluvial flooding. When considering our intervention, we discovered that a traditional infrastructural response, like building a seawall to protect the entire industrial area, would not only fail to address long-term issues of economic and social inequality, but would do little to transform Chelsea into a better place to live. While we did identify four critical pieces of infrastructure to protect with a multi-functional berm- a regional food distribution complex, a commuter rail line, an arterial road, and a highway- we also decided not to protect everything. In return, the low-lying industrial area could be converted to a floodable wetland area, creating new opportunities for green space and storm water management in the heart of the city. This iterative process of problem setting, identification of critical infrastructure, and design intervention, is a conceptual framework we call “bermanism.” Bermanism allows communities, planners, and policy makers to not only set strategic priorities, but imagine a transformative future in an era of climatic uncertainty. This intervention defines resilient infrastructure as more than an object: it is the result of a negotiation between social, environmental, and economic priorities. This conceptual framework for resilient infrastructure can be applied to other cities confronted by sea level rise. In doing so, it contributes to the literature by arguing that resiliency projects are most impactful when they include an iterative process of reflexive priority setting.

Keywords: problem-setting, Bermanism, resiliency, infrastructure, reflexive practice.

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## Resilience pathways of critical infrastructure in cities

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Global exposure to disasters has risen over recent decades; a trend which will likely continue alongside global climate change and as the majority of global population growth takes place in hazard-prone urban centres in Asia and sub-Saharan Africa. Cities are exposed to an increasingly diverse range of hazards including emerging cyber threats and terrorism. The rising cost of disasters is an increasing concern for the public sector and the insurance industry; direct losses from disasters in the last decade are estimated at US\$1.4 trillion. In 2017 a major research report: 'Future Cities: Building Infrastructure Resilience' was launched globally by Arup and Lloyd's exploring how designers, investors, city officials and insurers can work together to build resilient infrastructure systems. The report sets out new research, global case studies, and practical guidelines for infrastructure owners, practitioners and insurers. The report emphasises the importance of systems-level resilience across infrastructure planning, design, construction, operation and supply chains. The study analyses four different critical infrastructure systems - energy, water supply, Information Communications Technology (ICT) and transport - through case studies and consultation with global infrastructure sector experts. The three case studies demonstrate how infrastructure has been impacted by catastrophic events in the past, how stakeholders responded at the time, and indicates what actions they could take in the future to effectively address risk and enhance resilience at a systems level. This presentation will share the key findings from this research including: (1) an introduction to infrastructure resilience and city resilience concepts, (2) an overview and analysis of the key trends that affect city infrastructure risks and resilience, (3) discussion of the key city risk and resilience principles derived from analysis of real-world case studies and consultation with global infrastructure sector specialists, (4) analysis of the potential implications and considerations for infrastructure planning, design, and operation, including sector-specific insight, and (5) a series of recommendations and next steps that could help move action forwards within the insurance industry. The report identifies three approaches or "pathways" that can improve infrastructure performance after a shock or stress, supported by a number of specific and practical principles that city officials, asset owners, operators and other stakeholders can apply to planning, design and operations. These principles help to operationalise key resilience themes identified in the research such as decentralisation, diversification, redundancy, alongside inclusiveness.

Keywords: infrastructure; resilience; climate change; critical infrastructure; decentralisation.

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# The lost agency in control: a case study within the Atchafalaya River and Mississippi River Deltas

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Contemporary American littoral ecologies reflect an Industrial Age platform of thinking – one where human interventions are defined by the control of nature through the shaping of environment. This re-configuration of environment is an act to sustain constant methods of resource extraction, urban dwelling, and social practices. Obsolete mindsets of control, manipulation, and authority established in the Age of the Industrial Revolution are habitually reinforced through antiquated constructs of legislation, governance, and cultural debt. These constructs manifest in the form of static control infrastructures: levee walls, earthen levees, lock and dams, outlets, canals, pump stations, spillways, etc. The static networks were accepted centuries ago fostering centralized methods of control often surrounding a single node of preservation interest. Early implementation of these control networks distilled superficial values of ecological stability throughout the delta territory, spawning immense agricultural and industry growth within territories subject to dramatic environmental fluctuation. This false sense of permanence through static settlements is realized within these dynamic environments by the same, centralized system of control infrastructures, perpetuating urban growth. These networks behave as self-generating machines of growth, meaning every construct requires expansion – biasing value frameworks to urbanized infrastructural edges and de-valuing natural ecologies and buffer zones. The lost agency is defined through a continual commitment to authority over nature – distracting design disciplines, planners, and policy makers from developing new techniques of coexistence that work to eliminate centralized methods of control and promote decentralized methods of littoral settlement. The declaration from the 1927 Flood Control Act formalized through American Federal law sets forth the commitment to control nature, with man-made constraints defining pre-determined and allowed paths of water flows and limits. Cognitive effects of this defined approach include the reinforced division of humans and nature; the edge, established by mankind to mediate between the ‘natural setting’ and the constructed habitat of human artifice. The construct of edge as exists today is solely in service to protect human achievement [the anthropocene], reinforcing the division of man and nature and working in opposition to coexistence. Inherently, the concept of edge defines a border, creating an inside and an outside; the inside is depicted through notions of ‘protected’, ‘secure’ and ‘safe’. The first theme of the paper aims to provide the contextual work of the early environmental control infrastructures and the risk associated with these strategies – questioning the fundamental existence of the constructed edge and an interiority of territory. Through these means, the paper will argue the constructed edge has produced a singularity; a centralized method of existence that works to confine littoral settings. The second theme of the paper proposes the live edge – an ecological approach working with site-specific contours, settlements, and buffer zones to co-exist within the dynamic littoral environment. This approach demands the decentralization of existing static control infrastructures and requires the implementation of layered responses to evolving littoral environments. These concepts were generated from the research and design work of Pamphlet Architecture 36, Buoyant Clarity, and are expanded for the premise of this paper and proposed presentation.

Keywords: control-infrastructure; ecology; resource; edge.

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## The role of green infrastructure in improving urban resilience

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Research into urban resilience illustrates that there is a need for green infrastructure and sustainable drainage systems to be incorporated and implemented at an individual level as well as local, regional and national levels to improve the resilience of urban systems. When well designed, maintained and integrated into the wider landscape, green infrastructure enhances the performance and resilience of urban cities and contributes positively to the bio diversity of the environment while improving the wellbeing of the inhabitants. Green Infrastructure (GI) has clear links to natural capital and recognizes the wide-ranging economic benefits that natural assets provide when managed well. Green Infrastructure is often cost effective, resilient and capable of delivering multiple benefits and meeting objectives across social, environmental and economic themes. Incorporating well designed and managed GI into strategic infrastructure assets can improve resilience, increase its efficiency and performance, and deliver improved return on investment. This paper examines how green infrastructure improves the urban resilience to withstand extreme weather effects due to climate change and also enhance communities' and citizens' resilience. The aim is to investigate how key green infrastructure components can provide multidimensional solutions to multidimensional challenges in complex urban situations and provide inclusive, people-centered approaches to urban resilience. A scoping study that covers a broad-ranging literature review, case studies and action plans including government and other stakeholder reports, provide the foundation and an understanding of the wider context and the debate. The paper also presents the results of a stakeholder survey; conducted to establish priorities, identify challenges and barriers to incorporating green infrastructure elements in urban contexts. The findings will be beneficial to many stakeholders including government agencies and local authorities who are responsible for the implementation of green infrastructure strategies.

Keywords: green infrastructure, urban resilience, resilient infrastructure, climate change, extreme weather.

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## TRACK 3G

### Urban planning, urban design and resilience

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## Designing redundancy in urban landscapes: how, in times of emergencies, temporary uses transform normality

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Urban landscapes are deemed to build in a response to emergencies (sudden disasters, climate impacts). These urban landscapes need, however, to be prevented from becoming emergency landscapes, which are designed/planned for the purpose of dealing with disasters only. This would be a sad perspective for any urban landscape. Therefore, urban landscapes need to be able to build in redundant space in normal situation. In times of emergencies these spaces need to have the ability to transform, which implies multiple uses in urban landscapes, such as illustrated in the water square projects in Rotterdam and the Floodable Landscape, both in the Netherlands. These examples are used to derive criteria for increasing the resilience through creating redundant spaces and multiple uses in urban landscapes. The research objectives were (1) investigating redundancy in urban landscapes as a factor to increase resilience and (2) testing multiple uses in these landscapes as a factor directing the design interventions, leading to greater redundancy, increased adaptability and greater resilience in urban landscapes. To this end, two steps were taken: (1) design-led research testing design propositions against the criteria that have been derived from the former examples, and (2) reworking the designs accordingly towards preferential urbanization models. The analysis has been used to implement in the development of an entire new urban precinct in Western Sydney for approximately 1 million people. In this to-be-developed area redundancy is incorporated as the guiding principle to create landscape-based urbanism, in which dense urban precincts are peppered in the sensitive parkland area, using the urban and rural water system as the main driver for urbanization patterns, determining the mobility, densities and urban centers fitting within those structures and linking in ecological systems and the supply of renewable energy and urban food supply in the urban landscape. If the landscape is taken as the first driving force for determining the structure and system of urban landscapes, the redundancy of urban spaces can be increased. Then, in normal situations normal uses are put in place which allow, in times of emergencies, alternative uses in these spaces, transforming the urban landscape temporarily.

Keywords: urban design, resilient urban landscapes, emergency landscape, design-led methodology, temporarity.

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## Biophilic design toward urban resilience

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In order to mitigate climate hazards, urban resilience-building policy must adopt a framework that views cities not just as systems, but as ecosystems. Instead of approaching cities as distinct human inventions, urban resilience initiatives must frame cities as an interdependent part of the natural world. This idea draws from environmental ethics, systems thinking, and resiliency theory to assert that cities should be approached as complex ecosystems. Furthermore, this idea bolsters the assertion approaching cities as dynamic ecosystems aids flexibility and robustness for all species – both inside and outside cities. This is because green and biodiverse cities dually raise the environmental consciousness of residents alongside both mitigating emissions and increasing adaptability to disturbance. Cities rich with other species that hinge on innate human attraction to nature and natural forces – called biophilia – are best equipped to be resilient to climate change. Biophilic design and planning are well-known, research-backed mechanisms toward elevating both social and structural resilience. Despite this knowledge, even leading cities in climate change adaptation initiatives still generally focus on hazard mitigation that engineer biodiversity and natural forces out of urban areas. Proposed solutions are seldom rooted in working with nature, instead building barriers and bigger walls which aim to keep nature out. The adaptive capacity of structural solutions is rigid and even prohibitive of design for community resilience. Using New York City as a case study, a formal textual analysis presented on a poster will provide analysis of City plans and policies toward climate change adaptation and resilience to future storms. The database presented will rely on coded applications of the words resiliency (or resilience), sustainability (or sustainable), mitigation, and adaptation. Visualizations of coded language data will show how the City is approached with respect to planning for climate change – either as a human-centered system or as an ecosystem. Concluding analysis displayed will highlight the successes and challenges of existing policy and plans, applying theoretical approaches to show how framing plans through an ecosystem lens can strengthen urban resilience strategies in practice.

Keywords: biophilia; ecosystems; New York City; resilience; urban.

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## A strategic planning of resilient waterfront campus design

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This study was initiated by the understanding that building and operating a campus requires a campus masterplan reflecting locational characteristics and utilizing their merits and that especially a waterfront campus must reflect its geographical situation to create a sustainable and flexible campus. The purpose of this study is to propose a plan which can create a campus maximizing the locational merits of a waterfront campus and which bring a positive change in the shortest period, by exercising a campus's potential ability to respond actively, prospectively and synthetically to climate change. First, in geospatial terms, to upgrade waterfront campus masterplan in order to create a campus-town culture in the keywords of human, nature and water as a waterfront campus and prepare a place, space and natural environment for the members' community and exchange by getting out of the existing rigid frame of masterplan simply focused on constructing a building itself. Second, in physical and environmental terms, to create a resilient campus as a waterfront campus by demonstrating process technology to smartly answer climate-change demands regarding water, electricity, food, material, waste, spatial use, and landscape. This assumes understanding integrative disciplines of architecture, environment, water resources, energy, infrastructure, transportation, biology, business administration and IT, and building a flexible interdisciplinary relationship through a resilient mutual cooperation system. Future directions of implementing the resilient waterfront campus are as follows: first, as one of the basic principles most differentiated from the existing campus, safety against water which implies waterfront and resilience, to build a masterplan for waterfront campus in the keywords of waterfront, water, safety and landscape. Second, spatial, environmental features – a human and smart to contain sustainability of a campus and intelligence of all management, to build a resilient campus in the keywords of climate, energy, carbon zero, green growth and wastes. Third, fund operation for architectural, spatial use and socioeconomic sustainability, to construct integrated and creative system of mutual cooperation in the keywords of human, health, investment and social sustainability.

Keywords: waterfront; campus; masterplan; resilient, climate change.

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## Resilience, livability, and sustainability in the built environment after the Great East Japan Earthquake

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How could we enhance systems resilience to achieve sustainability and livability in the built environment following mega disasters, by what kind of intervention, and by whom? The author defines post-disaster recovery as a process to regain and achieve livability, sustainability, and resilience; three abilities expected to be rebuilt in the built environment. The research question in this article explores the relationship among these three abilities after the Great East Japan Earthquake. This study uses Geographic Information System (GIS) analysis of census data to identify the transformation of the built environment and a questionnaire survey for homeowners. There are two driving forces of the built environment transformation. These are government-driven recovery projects and individual housing relocation without planning, both of which trigger polarization between people and places that makes the built environment unsustainable. Government-driven projects improve robustness but disturb sustainability. Individuals' voluntary relocation represents resilient action, including robustness, rapidity, resourcefulness, and redundancy; however, this negatively impacts sustainability which means a trade-off relationship with resilience. These results imply that government-driven projects need downsizing, and we have to rethink how to intervene to mobilize peoples' resilience to pursue sustainability and to redefine livability in the process of recovery to minimize trade-offs.

Keywords: resilience; relocation; built environment; housing reconstruction; the Great East Japan Earthquake.

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## FLOODLABEL: how new planning tools create flood-resilient cities

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Annually, floods cause immense economic and human losses around the world. To create resilient communities, current flood risk management strategies in urban areas have to amend in light of changing climate patterns. To assess current approaches in urban areas, and to develop future management strategies that are tailored to dynamics in frequency and magnitude of flood hazards, a sound and accurate understanding of resilience is crucial. Urban resilience is derived from the understanding of ecosystems resilience. Thus, urban resilience is understood as the ability of an urban area to absorb turbulences and learn, adapt or reorganise following a disturbing impact. The aim of this paper is to improve resilience and adaptive capacity of cities in a smart manner to sustain urban living in Europe. We present the FLOODLABEL prototype, a new geo-technology and ICT-supported instrument, which can involve both private stakeholders and civil society in the decision-making processes. The results show that flood labels are able to integrate the expertise from risk assessment studies, spatial simulation, urban planning and planning support science to enhance urban resilience. Nevertheless, the implementation of flood labels request governance arrangements, which trigger new communication pathways. However, the presence of new smart tools raises the discussion of who benefits from the hazard information provided and whether co-producing knowledge can improve such communication pathways to move towards more resilient communities. Thus, the question arises, whether hazard tools generate knowledge or solely act as means of marketing flood protection and mitigation solutions as well as direct urban hazard management towards privatisation. This can in turn influence the market value of properties and, thereby, fundamentally question social justice within new risk communication tools, as such developments can lead to greater inequalities within society.

Keywords: smart tools; urban resilience; planning support system; urban planning; urban design.

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## The role of urban form in supporting rapid tsunami evacuations: using computer-based models and real-world data as examination tools

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Large populated coastal areas in Asia, Latin America and the Caribbean are exposed to destructive near-field tsunamis, fostering the need for physical urban forms capable of supporting populations' rapid response actions to tsunamis with short arrival times (e.g. evacuation and sheltering). In recent years, computer-based models have become powerful tools to examine both the role of the urban form and the emergent evacuation processes during tsunami emergencies. Challenges still exist, however, in validating these models and in examining real-world human behaviour. This paper addresses this shortfall through (1) developing a GIS-based urban form analysis of the Población Vergara district in the tsunami-prone city of Viña del Mar, Chile; (2) carrying out an agent-based computer simulation of a tsunami evacuation in this district; (3) undertaking an analysis of the mobile phone call records (i.e. time and location of each call made by around 16,753 users in the study area) during an actual tsunami warning occurred in Viña del Mar on September 16, 2015, triggered by a Mw 8.3 earthquake near Illapel, Chile; and (4) comparing the results from items (1), (2) and (3) above. The comparison shows that at the macro-scale of urban configuration the district's urban form is well suited for rapid tsunami evacuation (as the result of its orthogonal, dense and well-connected grid of streets, which provides short routes to high ground, increases redundancy for evacuation, enhances orientation and promotes a better distribution of evacuees). Nevertheless, significant gaps were between official evacuation protocols and goals, and modelled and observed population behaviours and tsunami characteristics. It is particularly important the unfeasibility of accomplishing established time thresholds for full evacuation (15 to 20 minutes), given the likely tsunami flood parameters, existing urban configuration and evacuees' actual evacuation behaviour. These findings pose significant implications for Chilean authorities, urban planners/designers and emergency managers, and they provide valuable real-world data to improve the city's urban form and emergency management protocols for future tsunami crises.

Keywords: urban form; tsunami; evacuation; computer-based models.

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# Strategic urban interventions to align humanitarian response and sustainable urban development: the case of the Bungamati Action Plan, 2015 Gorkha Earthquake, Kathmandu Valley, Nepal

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Recent international policies stress the need to (re)build more sustainable and resilient in order to decrease urban disasters that follow natural hazards and to transcend the humanitarian-development divide. Urbanism, as a dynamic process of adaptation over time, is a key discipline in DRR and humanitarianism, that can operate simultaneously within timeframes of longer-term development and shorter-term (con)temporary interventions. The proposed paper illustrates and evaluates the methodology of the action plan made for Bungamati, a town situated South of Kathmandu, made after the 2015 earthquake. The action plan mainly proposes an urban strategy, inscribing itself in the existing settlement structure, sensitive to the seismic building culture and its livelihoods. The plan doesn't aim at an overall comprehensiveness, but stems from an acupunctural approach. Strategic urban interventions, carefully set out in time, operate as urban projects with a dual scope: whilst partially (re)constructing the urban tissue, they simultaneously transform the larger context. These strategic urban interventions were coproduced by the community, local and international experts, and policy makers, and mapped, documented and visualised to seek for specific donor and stakeholder engagement. They gathered and directed initiatives towards a joint effort aiming at once for a sustainable (re)construction. On the 14<sup>th</sup> of September 2015, a plenary Action Plan presentation with all involved stakeholders (Ministry of Urban Development, Kathmandu Development Authority, Karyabinayak Municipality, the Bungamati Relief Committee, UNESCO, several academics and representatives of the village among others) was facilitated by UN-Habitat. On the 16<sup>th</sup> of January 2016, Prime Minister Khadga Prasad Oli inaugurated the Action Plan. The objective of this research is to evaluate the methodology of the action plan, through strategic urban interventions, conceived as mediating between both (early and later) recovery initiatives, and long-term sustainable (re)development, rooted in the genius loci of the site, while answering to the current and contemporary expectations of inhabitants and the current urban challenges. This paper draws upon fieldwork maps and interviews in the making of the Action Plan in 2015, and is complemented with drawings, maps and interviews monitoring the Bungamati recovery process from 2015 onwards. This graphical dissection of the urban tissue is theoretically framed back through literature study. The Action Plan has worked as a catalyst. The coproduction and its nature stimulated its appropriation, with a largely self-governed (re)construction process as a result. The urbanisms projective capacity of visualising possible outcomes drew a common ground for both short-term recovery and longer term (re)construction projects and thus concrete collaborations between diver's stakeholders. It has moreover inverted the humanitarian supply-chain: the strategic urban interventions facilitated a demanding position rather than a receiving one. The case of the Bungamati Action Plan shows that strategic urban interventionism can mediate between the timeframes of emergency and development. It empowers (local) humanitarian and grassroots initiatives that emerge right after the disaster and works mobilising for a complex and wide range of donors, ministries and stakeholders, as their initiatives and donations plug into a longer-term urban framework. This projective methodology can thus facilitate a context-specific humanitarian response fitting urban development goals.

Keywords: 2015 Nepal Earthquake; humanitarian-development divide; strategic urban interventions; self-governed (re)construction process; context-specific response.

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## Designing safety: an approach to ways of living and coexisting with socio-natural hazards in the Metropolitan Area of Concepción, Chile

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Concerns about the effects that natural disasters have on people, economy and environmental deterioration, continue to increase globally. The objectives of UN-Habitat (e.g. to achieve a more sustainable development in the world) and the Sendai Framework 2015-2030 for Disaster Risk Reduction indicate the relevance of people and their social, political, cultural and environmental context, in the processes of adaptation and to build a more sustainable and safe society. In the meantime, the process of industrialization that Chile has experienced since 1939, especially in the Metropolitan Area of Concepcion, fostered by the Poles Development Approach implemented ever since, has promoted a progressive change in land use and an ever-increasing urban population, especially in areas exposed to different socio-natural hazards (e.g. flood, tsunami, landslide, wildfire, earthquake and industrial risk), where urban and architectural design have not considered risk as a relevant variable in city design projects. In this context, the main goal this research seeks is to identify the aspects of urban and architectural design that have increased the socio-territorial vulnerability to the tsunami risk, in the built environment of the San Pedro de la Costa settlement, in the Metropolitan Area of Concepcion, in order to promote measures, based on the greenfield and brownfield approach as key, to reduce socio-territorial vulnerabilities and to build resilient communities. Regarding the main methodological aspects, this project develops a descriptive and applied research, focused on the interpretation of the topic of disaster risk reduction, from different angles, to reach conclusive and significant findings. For the methodological design, we applied a morphological analysis and transect analysis, complement with observation and REDATAM specialization data, for determined networks and space occupation. In addition, a documentary analysis is carried out to understand the relationship between the development approaches implemented in the last 70 years and their relationship with the processes of land-use change in the study area. Main results indicate that strong land-use changes happened in the last 40 years, increasing the forestry industry and urban expansion processes. On the other hand, the actual criteria of space occupation respond to the past approach of inhabit the territory, and the present occupation and land-use plans regulate acts where the architecture and urban design do not necessarily coexist with the environment and natural hazards existing, promoting territories at risk, that require the implementation of structural measures, friendly to the environment, to reduce levels of vulnerability and design a safe, sustainable and resilience city.

Keywords: resilient architecture, urban design, land uses, development.

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## Climate Action Zones: a clustering methodology for resilient spatial planning and design in the face of climate uncertainty

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Southeast Florida faces both risk and uncertainty associated with climate change. Chronic “sunny day flooding” at high tide, as well as increased frequency of tropical storms and hurricanes, require an innovative approach to protecting assets and allowing future development. To respond, it is imperative to consider underlying environmental conditions as a foundation for adaptation. While strategies exist for areas with known hazards, less attention has been given to areas that include high elements of uncertainty. Using data provided by Broward County, Florida, the joint team of MIT Urban Risk Lab and the University of Toronto is developing an innovative approach that focuses on delineating Climate Action Zones based on unique environmental risk profiles and machine learning, using geospatial data sets with eco-morphological attributes such as soil permeability and seasonal water table heights, salt water inundation, storm surge heights, and ground elevation. We use a k-means/k-prototypes clustering algorithm and machine learning to identify 8 distinct landform classes based on similar clusters, which we have interpreted to define 8 unique “Climate Action Zones” (CAZs). The 8 zones can then be categorized into high risk, low risk, and zones of uncertainty. These designations can function as a starting point for policy. For example: high risk zones may be sites for downzoning or managed retreat programs; and low-risk zones may be more suitable for densification and future development. Zones of uncertainty include areas that have both a lack of available data as well as variability in the data that makes it difficult to decide a precise path forward but, as a result, provide an important opportunity for innovation in planning and design practices. Within these categories, architects, planners, policy makers, and communities can work together to set priorities and define short, medium, and long-term objectives: to minimize exposure to risk in vulnerable areas; to encourage development in safer areas; and to promote innovation in areas where risks are uncertain. Such innovation includes rethinking traditional land use planning and urban design principles and developing new strategies informed by the ecological resilience characteristics of modularity of connectivity, which can buffer the spread of disturbance, and functional diversity, which emphasizes the distribution of diverse system components. Although Climate Action Zones provide interesting opportunities for addressing environmental hazards and dealing with uncertainty, this methodology does face some limitations, including path dependency and institutional lock in, limitations with data, and costs of implementation. Climate Action Zones do not determine specifically what actions a community should take but instead provide planners and policy makers with a starting point from which to build resilience to increased climate change-related disturbances through adaptive land use planning and urban design practices rooted in eco-morphology. This methodology is a preliminary exploration of spatial planning and design that combines managing risks with opportunities to innovate in the face of the unknown.

Keywords: climate change; adaptation; socio-ecological resilience; urban design; machine learning.

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# Enabling adaptive capacity of urban neighbourhoods through architecture and urban design in the face of human-induced hazards: the case of urban decline

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The aim of this study is to form a conceptual framework by drawing on qualities of neighbourhood and adaptive capacity in order to strengthen resilience and adaptive capabilities of neighbourhood that will face with stresses or consequences of urban decline. The central arguments of the study are that neighbourhood is a dynamic system (a) which could adapt itself in order to mitigate shocks in the occurrence of urban decline, and (b) which establishes critical connections within the city and is a key for the resilient city. The emphasis is on triggers of urban decline, dynamic and non-linear relations in a neighbourhood, variability in scales (time, space, and context) of adaptive capacity as well as physical and social construct of the neighbourhood that should be considered in an integrative approach. The study concludes that focusing merely on the hazard will present limitations to enable necessary adaptive measures to the system. In this regard, triggering conditions and dynamics should be defined in detail. Also, adaptive capacity of neighbourhoods could be enabled through structural and non-structural measures in advance to urban decline provided that space, size, context, time, and drivers of the dynamics are established.

Keywords: neighbourhood; adaptive capacity; urban decline; urban resilience.

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## Walking as a key factor in the resilient low-carbon city

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Future cities will increasingly face wicked problems relating to climate change and fossil fuel scarcity. Reduced CO<sub>2</sub> emissions and planning cities for resilience against fossil fuel scarcity are important tasks for planners and designers. The planning and design of 'resilient walking neighbourhoods' could contribute as a partial solution for many issues. In this research, the focus is to improve or redevelop 'resilient walking neighbourhoods' to prepare for fossil fuel scarcity in the future. Therefore, there was also a need to undertake in-depth studies of existing conditions in different neighbourhoods in various locations, which the researcher has chosen to undertake using two methods. One is an in-depth study of cases in Melbourne in urban settings local government areas of (Port Philip, Moreland, Hume) and some cases in internationally well-established walkable neighbourhoods (Freiburg, Germany and Malmo, Sweden) to gain richer data and to compare the scale of resilience to fossil fuel scare city in Melbourne cases with international cases. The analysis of resilience and walking related values using key literature provided opportunities to reveal the most resilient walkable neighbourhoods in the case studies. The paper shows the key urban place characteristics of walkable, resilient neighbourhoods. Methodologically, both qualitative and quantitative methods are used in different parts of this study in keeping with a 'convergent parallel mixed method' approach. Data collection was conducted through mapping and field observations of key urban place characteristics, and face to face interviews with residents and users about their walking experience within 400-metre sample neighbourhoods. Prior to each data collection day, the researcher observed the streets with the highest frequency of users to collect the information, as the most frequently used streets can provide valuable data. The research scope was limited to two main streets from each neighbourhood due to time and resource limitations. The interviews were carried out with ten people in each sample neighbourhood, with participants having to be 18 years and older for ethics requirements. These interviews took approximately 15-20 minutes, with most of the questions being open-ended, while data were also manually recorded on A4 paper sheets. Sample questionnaires were prepared in parallel with empirical research data. These questionnaires gathered the perspective of the locals in relation to the built environment and how they feel about 'resilient walking' in their neighbourhood; what their neighbourhood lacks, and their suggestions for change if any. These data collected and assessed in the case studies show the existing resilience levels of neighbourhoods regarding fossil fuel scarcity. Therefore, the key urban place characteristics which represent the most 'resilient walkable neighbourhood' can be taken as an example to improve neighbourhoods towards less fossil-fuel dependent scenarios. The results help to identify neighbourhoods' key urban place characteristics that commonly contribute to or take away from walking resilient neighbourhoods. It suggests that the findings could provide directions for better development control to improve neighbourhood planning and design over time as development occurs. It will make the future cities more resilient to fossil fuel scarcity and could also lead to low carbon interventions.

Keywords: innovation; resilient; urban place characteristics; walkability.

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## Reducing disaster risk through fire-resilient cities

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Disaster risk reduction (DRR) is a concept and practice present for several years. Through organisations such as the UN, the EU, and NGOs, some steps have been made, but the work itself is never ending. Disasters represent a risk to our societies that we must learn to live with. Therefore, research on disaster risk reduction is crucial and finding ways to increase the resilience of our cities is one of the topics we should address. There are many areas where resilience should be increased. However, this paper will focus primarily on structural and non-structural measures when looking at fire as a hazard. Fire has been the cause of disasters for hundreds of years and though a lot has changed with time, the events of Grenfell in the UK or the Kemerovo shopping center in Russia show that there is still a need to learn and reconsider how we can guarantee fire resilient buildings to our citizens. As cities are getting more crowded, the need for developing sustainable cities is growing. Urbanization requires that we build closer and higher, all at a fast pace. However, fire resilience is often forgotten in the equation. Therefore, the objective of this paper is to discuss fire resilience, more specifically high-rise and high-risk buildings' fire safety regulations, both at the EU level and at national level. At the EU level, we describe the EU's involvement in the field of fire safety with current projects. For the national level, our focus is on fire safety regulations for high-rise and high-risk buildings in Sweden, UK and France, to represent the different systems. We are then discussing the role of building products in assuring fire resilient cities. Our findings demonstrate that there is a conflict between the need for a fire strategy at the European level and the different fire safety regimes across Europe. As fire is a national competence, the EU is not able to regulate. However, the EU can make recommendations and support the collaboration between member states in fire safety matters. Another finding is that the national regimes must be updated regularly to fit changes in cities. For example, energy renovation programs propose the use of different materials or different ways to build which should be evaluated, not only in terms of energy efficiency but also of fire safety. Finally, building products can increase fire resilience and therefore must be chosen carefully. To contribute to disaster risk reduction and resilient cities, we must work on better understanding the impact of the hazards we are facing. Fire is just one of them, but with this paper, we have demonstrated that we still can get better at increasing resilience if we get our focus where we can make a difference.

Keywords: building products; EU; fire; regulations; resilience.

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## Building resilience: an adaptive framework for Greater Bay Area sustainable development

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Resilience as a goal of climate responsive design presents new challenges to architects. Their responsibilities for the increasingly risk-prone Greater Bay Area (GBA) are critical. The concept of resilience is coined in post-hazard protocols evaluating the ability and capacity of systems to persist. However, according to Gunderson (2000), this engineering perspective on resilience is inadequate because of the assumption on a system at equilibrium. Holling (1973) argued from an ecological perspective focusing on the “ability of a system to return to equilibrium after a temporary disturbance.” Urban researchers Laboy & Fannon (2016) similarly applied this theory to the built environment. They agreed that “architecture is neither stable nor resilient, washed by tides of ecological deterioration, cultural devaluation, and economic disinvestment.” I argue that the integration of knowledge with public engagement and adaptive designs is vital to address urban vulnerability. Flynn (2016) characterizes urban vulnerability as islands of resilience awash in a sea of fragility. He recognized that architecture is not mere physical building, but as a network of systems. Cultural values and design theories distinguish architecture from buildings. Hence, Robustness, Redundancy, and Resourcefulness in the engineering perspective are basic, yet limited. Additional of Risk Avoidance, Rapidity, and Recovery prior and after the event are keys to systems of different scales in transferring the state of equilibria in creating opportunities and advancing preparation. Understanding adaptive resilience as a network of systems, the objective is to investigate the interface between buildings and neighborhoods. We would analyze the impact of regional resilience framework on neighborhoods and how the strategies address the unique localities in GBA area. Firstly, in the context of this mega-city, risky locations such as seacoast and floodplains confer important benefits. The buildable land, well-appointed sites for collection, and transshipment of goods set GBA apart from land-locked regions. Nevertheless, it is alarming that the initial developments without risk avoidance strategies build on available safe sites, but subsequent growth spills over to high-risk areas. Secondly, new development without rapidity consideration paving over water-sheds reduces infiltration, speeds runoff, and increases flood volumes. The impacts of creating conditions for disaster are also opportunities to enhance resilience by implementing adaptive strategies, like blue-green infrastructure. Lastly, mega-city escalates the disaster potential by concentrating people and investments. The disproportionate amount of material wealth is bound up in the built environment. Historic typhoons inflicted billions of properties damage in GBA which took weeks to resume. Harnessing inter-city resources, by investing recovery, can better prepare back-ups and enhance restoration. Therefore, I conclude that a potential road map of how resilience as a dynamic design strategy can tackle the climatic and geographical characteristics of GBA socially, environmentally, and economically for a sustainable future.

**Keywords:** communities; ecological resilience; governance and leadership; integrative design framework; mega-cities.

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## Climate Change Adaptation in big urban centers: the case of New York City

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New York City has 835 km of shoreline that is very diverse with different neighborhoods, densities, land use and building types. A big portion of these areas is subject to flooding and was heavily impacted by Hurricane Sandy in 2012. The Department of City Planning aims to ensure that zoning and land use policies reflect this diversity, while allowing the city's coastal neighborhoods to adapt to flood risks overtime. As New York City's context is unique, it is evident that the city cannot solely retreat. Therefore, most of the city's policies are to support the planned density through a multi-layered defense strategy, which includes investments in coastal protection and infrastructure, community preparedness and flood-resistant construction. However, in certain areas where risk is exceptional, Department of City Planning is looking at managed retreat strategies, which involve limiting future density. On the other hand, in areas where risk can be managed, regulations can encourage density in order to increase the resilient building stock while supporting investments in coastal protection. The Federal Emergency Management designates New York City's current flood risk by mapping the Special Flood Hazard Area, which is the area that will be inundated by a flood event that has a 1-percent chance of being equaled or exceeded in any given year. Sandy inundated beyond the current risk mark, both in storm surge and geography. Additionally, with climate change, sea level rise will increase the likelihood of these events, while also increasing the potential height of the storm surge. Therefore, Department of City Planning recognizes that only addressing the current floodplain is limiting, thus sea level rise projections issued by New York City Panel on Climate Change have been taken into account in the planning process, as these estimates are valuable in flagging areas that will be impacted by daily tidal flooding by 2050, as well as projecting the areas that will likely become the future floodplain. This analysis, in conjunction with 10 neighborhood-specific studies that were developed right after Sandy, informed the need to develop the Special Coastal Risk District: a zoning tool that limits future density and prohibits community facilities with sleeping accommodations, such as nursing homes in localized areas that will be heavily impacted by sea level rise. This tool can be mapped on a case-by-case basis to disallow additional vulnerable populations in the high-risk areas and to allow the city to adapt to climate change overtime. Furthermore, Sandy demonstrated that buildings designed to flood resistant construction standards, could better sustain the impacts of coastal storms. Therefore, the city has been encouraging higher densities in areas that are not as vulnerable to flooding and are in the process of receiving investments in coastal protection. These areas could benefit from additional development rights to increase the resilient building stock while also supporting infrastructure investments. This work explores the different strategies of New York City's land use policies and how this model can be an efficient way to advance climate change adaption in big urban centers that are vulnerable to flooding.

Keywords: zoning and land use; climate change policy; future density; planning tool; urban centers.

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## Urban ecological planning as a long-term instrument for risk governance in Guangzhou

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Topic and research background: Urban ecological planning (UEP) has been adopted in many Chinese cities as a means of restoring the degraded urban ecosystems resulted from the country's rapid processes of urbanisation, socioeconomic development and population growth over the past four decades. The aim of UEP is to steer sustainable socioeconomic development and achieve the national environmental agenda – ecological civilisation. The complexity of the urban environmental degradation prompted the central and local governments to plan for comprehensive actions to govern risks and to foster resilience while trying to promote sustainable urban development. Urban ecological systems, with its multiple ecosystem services, is essential to assisting urban environments to rebound from pollution and environmental degradation, hence building resilience to climate change impacts and benefiting the health and wellbeing of urban inhabitants. Therefore, UEP is well aligned with the Sendai Framework's aim to manage the changing dynamics of human-nature linkages in cities to stay resilient within planetary boundaries. What is the role of UEP in environmental risk governance and what can UEP contribute the sustainable socio-economic development in megacity Guangzhou? This key question leads to an empirical knowledge inquiry on ecological planning policies and actual governance model, from which the paper proposes ways forward for governance innovation in sustainable development. The paper has three-fold objectives: 1) to critically analyse the guiding principles and major goals of UEP policies in Guangzhou, 2) to understand UEP's role in risk governance in Guangzhou through illustrating the institutional and policy frameworks, and 3) to propose ways forward for resilience thinking in UEP and governance innovation in sustainable development. Building on the summary of relevant theories and concepts including risk and resilience, sustainable development, environmental governance and urban planning, the paper possesses an empirical focus by conducting in-depth interviews to key urban ecological planners and carry out policy analysis. Findings or (expected) results include: 1) UEP, departing from its urban ecology perspective with an aim to restore the urban ecosystems, composes a fundamental part of risk governance in Guangzhou. 2) Despite thriving liberty in socio-economic development, risk governance in Guangzhou is mainly a top-down model yet is in a transition towards more collaborative, inter-sectoral governance. 3) The notion of resilience used in UEP in Guangzhou is mainly on the technical (environmental) level, which is insufficient for risk governance. The success of the latter also requires broad socio-economic engagement taking into account the fast-changing dynamics of urbanisation in Guangzhou. The fact that Guangzhou adopted the UEP as a systemic approach to resolving environmental degradation reflects the government's long-term vision for risk governance and value for human-nature harmony. The stable institutional and policy frameworks are a guarantee for the implementation of the UEP. However, the lack of socio-economic engagement in implementation UEP is a gap in which the government needs to address, in order to provide passages of transition to the additional aim of risk governance in Guangzhou - to promote sustainable urban socio-economic development.

Keywords: urban ecological planning (UEP); risk governance; resilience; sustainable socio-economic development.

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## Teaching resilience for urban planners and architects

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Resilience has been widely discussed about in the last decade, and one of its definitional characteristics is its fuzziness. Different approaches have been adopted in academic and policy literature, with different applications of the term in every aspect of our lives. Urban resilience, in particular, has been defined by Arup and Rockefeller foundation as “the capacity of individuals, communities, institutions, businesses, and systems within a city to survive, adapt, and grow no matter what kinds of chronic stresses and acute shocks they experience”. Furthermore, several researches consider urban environment as a complex, able to self-organized and learning system in constant change, moving forward from a disturbance and they argue that urban adaptation/transformation is the key feature of urban resilience. In general, the approach of resilience used in urban planning, and the means and practices of its implementation in cities, has always its challenges. One of the biggest challenges of the concept is that, it is local and diverse, and not standardized which deals with countless interactions. Moreover, cities are very dynamic and their ever-changing circumstances can cause challenges in adaptation, but is also a concept that greatly benefits the cities to come to the terms with their vulnerabilities, whether it be infrastructure, natural disasters or human caused stresses. However, there is also the challenge of how to connect theory to practice with concept of resilience and over the years the authors of this article have found this to be a challenge in their research and teaching. With this in mind, collaborative lecture series were designed to teach a graduate course called ‘Resilience’, where two different student groups from two different countries (and cities) explored the concept of city resilience as their project in their course and explored the concept of city resilience in their local cities. One of the groups was based in Greece and were Regional and Urban Planning graduate students. The other group was based in Cyprus and were graduate students in Architecture. The two programs were shaped in such a way, as to have a common theoretical origin, based on the framework for resilience researched about globally, and were further specialized, being adapted in the equivalent local specificities. Parts of the programs were common lectures, presentations, and progress reports. This paper, not only discusses the approach used by the authors to teach the concept, but also focuses on how the students used the existing resilience concepts in their project and discusses the challenges and the learning outcomes from the course.

**Keywords:** Resilience; urban planning; architecture; teaching style.

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## TRACK 3H

### Building capacity through infrastructure

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## A risky business: the impacts of hazards on traders located in different marketplaces in Port-au-Prince, Haiti

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On February 13, 2018, a fire ravaged the Iron Market, one of the most iconic marketplaces in Haiti's capital, Port-au-Prince. The event, symptomatic of the vulnerability of marketplaces in many low- and middle-income cities across the world, impacted hundreds of petty traders. Yet, marketplaces are overlooked as an important urban infrastructure in urban resilience and petty trade studies, as well as in urban planning and humanitarian practices. In response, this paper explores the influence of marketplace infrastructure and environment on traders' capacities to fulfil their needs and to maintain or rapidly return to trade after facing hazardous events. The paper is primarily based on the analysis of 125 trader interviews conducted in four distinct marketplaces in the Haitian capital, Port-au-Prince, in 2017. It is organized into four parts. First, the traders and four marketplace environments are profiled to appreciate the role that petty trade and the different marketplace environments play in the lives of traders. Second, trader accounts of shocks and stresses in the marketplace are presented to underline the distinctions between different marketplace environments. Third, the financial impact of the loss of marketplace assets due to the earthquake and fires are explored, as well as the differences in return-to-market speeds between marketplaces. Finally, these findings are discussed to explore the ways marketplace infrastructure may influence traders' capacities to maintain trade and fulfil their household needs during crises. Findings suggest that traders located in a covered market which withstood shocks were better positioned than their counterparts in other markets to sustain their household needs as they were able to restart trade relatively quickly. In contrast, traders in covered markets which collapsed were impacted the most as the loss of market assets were absorbed within the domestic sphere and the ability of traders to borrow. This also resulted in longer recovery time and in the reduction of traders' capacity to direct income into meeting household needs. Traders in open-air markets may be less affected by the earthquake but endure worse working conditions and exposure to meteorological hazards. These findings pose several implications for research and practice. The study supports the need to examine marketplaces in low- and middle-income cities in empirical studies on urban resilience. It also exemplifies how the failure of an urban infrastructure can impact households located remotely. Findings also demonstrate that traders face different risks depending on the kind of environment they occupy. Finally, it provides additional evidence for local governments and non-governmental organizations in Haiti, and internationally, to consider marketplace infrastructure in their strategies to build resilience for low-income citizens.

Keywords: marketplaces; traders; resilience; hazards; urban infrastructure.

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# Managing risks from critical infrastructures: elements of infrastructure interdependencies that have the potential to affect the post-disaster recovery

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Society demands that infrastructures operate constantly in an ‘always-on’ mode. However, interdependencies that exist between critical infrastructures such as energy, transport, water (including sanitation), as well as information and communication technologies make them more vulnerable and exposed to natural disasters. Such vulnerability induces greater challenges to post-disaster recovery efforts, particularly when faced with failures extending simultaneously across multiple infrastructures during the recovery period. The restoration of interdependent network systems following a disaster remains an immense challenge to most organisations. This is due to the fact that there is no unifying theory that can serve as a common standard for rehabilitating interdependent systems during post-disaster recovery. Accordingly, no adequate modelling or simulation technique have been previously utilised to provide an integrated network analysis which could evaluate the impacts of infrastructure interdependencies on post-disaster recovery processes. This paper investigates elements of infrastructure interdependencies that have the potential to impede the post-disaster recovery. Using an exploratory study, the current paper contributes towards an understanding of the risks that interdependencies pose to the post-disaster recovery of large infrastructure systems.

Keywords: Post-disaster recovery, critical infrastructure, risk management, infrastructure interdependency

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## Vulnerability and infrastructure inadequacies: building better humanitarian facilities

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Aged humanitarian aid agency infrastructure that is poorly constructed can become a major hazard for those working in such environments and those it is expected to serve and support. Similarly, when urgently required new humanitarian facilities are poorly planned and built they can negatively affect already vulnerable communities, complicate relief efforts, cause problems with emergency resource storage and distribution, and hinder disaster recovery. Human resilience is increased when built environments are well considered and constructed, and respond to local conditions, material resource availability, new knowledge and technological advancements. However, the urgency, unpredictability and lack of financial support, resources and technical knowledge that often informs these situations prevent well considered solutions being implemented. Also very often government support for such facilities is minimum and bureaucratic processes and political agendas hinder the attempts of aid agencies working in these situation. This paper looks at how humanitarian facilities can benefit from a better architecture, one suited to the local conditions and vernacular resources available to ensure an infrastructure that supports the safety needs and functions of these facilities. The paper also looks at how the resilience of this architecture can be achieved easily and efficiently. Using a case study approach the situations in two refugee camps are explored. The Cox's Bazaar camps in Bangladesh where over 1.3 million refugees are sheltered making it the largest refugee camp in the world is investigated. It is examined for the quality of its infrastructure and to understand what might be done differently to improve conditions and to support its primary functions, in particular through environmental changes as the monsoon rains and droughts. The aim is also to identify strategies for building a more resilient infrastructure in a similar future situation and avoid the same issues from recurring. The Manus Island refugee camp in Papua New Guinea is the second case study. The infrastructure inadequacies that have compromised the health and safety of the refugees and the wider community and aggravated the vulnerabilities of both groups causing tension between them are studied. This is done with the intention of identifying ways of remedying this situation and devising strategies for avoiding such issues in the future. A comparison of the two case studies to similar humanitarian aid facilities in other parts of the world demonstrates that the issues are similar and how as infrastructure ages they severely compromise health, safety and functional efficiency. Research findings show a key reason for this to be that humanitarian infrastructure is often intended as temporary or for a short term. The paper draws solutions from research conducted on traditional and vernacular communities and built environments from Asia and the Pacific. The resilience of these communities and their living environments provides solutions and systems for increasing safety and efficiency. Research findings also demonstrate how greater engagement with displaced, local and volunteer communities and working in partnership with local organisations can lead to stronger systems planning and better infrastructure design while also building capacity amongst vulnerable communities.

Keywords: Infrastructure inadequacies; humanitarian architecture; refugee camps; building better; resilience

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## Evaluating service level of Points of Distribution (PODs) during the Michigan Flint water crisis

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In the United States, drinking water is delivered to communities by one million miles of pipelines. Most pipeline systems were constructed in the early to mid-20<sup>th</sup> with a lifespan of 75-100 years. Currently, there are approximately 155,000 active public drinking water systems. It provides drinking water to 90% of Americans. The quality of drinking water remains high, but the legacy and emerging contaminants need to pay close attention. When public drinking water systems are unable to deliver safe water, the provision of emergency water supply becomes a necessity. Depending on the incident scale and duration, temporary or existing emergency water supply system could not support the tremendous amount of water needs from an affected community. The Flint water crisis, Michigan in the U.S. began in 2014 as the drinking water source for the city of Flint was changed to the Flint River to reduce the water fund shortfall. In October 2015, more than 90,000 Flint residents were directed not to use their lead-contaminated water. Instead, they were asked to use bottled water. To fulfill the huge and growing amount of water needs from the residents, the city initially utilized five local fire stations as Points of Distribution (PODs). Then, the city opened new nine PODs to increase the POD capacity and accessibility of the residents. The objective of this study 1) reviews existing emergency water distribution system including POD strategy and operation 2) conducts spatial analysis to evaluate spatial and social equity of the PODs operated during the Flint water crisis. We found that there is limited literature to provide an effective POD planning and operation guidelines for delivering bottled water and emergency supply kits, especially for an intermediate-, and long-term emergency water distribution. Also, the PODs in the city were primarily sited to provide equal distance to the affected residents. The average distance to PODs from the residential areas was 3.43 miles (five fire stations) and 2.78 miles (nine PODs). However, three out of nine PODs had significantly higher water demands than the other PODs. The average number of assigned households to the nine PODs was 5,754, and the standard deviation was 2,573. Finally, we identified that the POD locations relatively satisfied spatial equity, not social equity such as low income and minority. The results of the study will be used to understand the role of spatial and social equity in POD planning and operation as a public facility. Further, it will be used to develop a framework for an effective POD design and location for the future water crisis in urban areas.

Keywords: water infrastructure; emergency water distribution system; point of distribution; social equity; water crisis.

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## TRACK 3I

Disaster Risk Reduction through communities' participation: gender,  
education, religion and culture

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## Social cohesion through urban planning: strengthening community resilience in multi-ethnic urban neighbourhoods

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The social infrastructure of a city plays a critical role in preventing and mitigating severe damage during crisis and disaster situations or in times of rapid social change. Similarly, post-catastrophe recovery is also essentially based on a sense of community that connects the members in disaster-struck neighbourhoods. Numerous studies have shown that social cohesion constitutes a significant factor in strengthening the resilience of a community. Sociological research into the ability of communities to withstand disasters has coined the term of “community resilience” as an adaptive and coping mechanism of social systems for dealing with unexpected external disturbances (including natural disasters, technical accidents, economic crises or social unrests). The concept of community resilience locates adaptive and coping potentials in social processes as well as in both the individual and collective capacities of members of society. Resilient societies can thus call upon the social and self-help abilities of their citizens, which are developed and proven in the normality of everyday social life. Urban planning contributes significantly to the promotion and organisation of public life. Particularly the public space is an important place of communication for which urban planning strategies create offerings to connect people and to actively experience social participation. However, in multi-ethnic societies trustful relationships among neighbours and an active participation in social life are frequently put into question. Ethnic-cultural heterogeneity and social cohesion often seem to be negatively related: The more diverse a society or a community, the lower the willingness of its members to develop close ties with their fellow community members and to intervene on behalf of a common good (e.g. ensuring safety and security). Urban planning thus faces the challenge of developing convivial neighbourhoods that promote and foster social cohesion and a sense of community in an increasingly heterogeneous context that enables diverse communities to pursue collective-action efforts and to provide for collective goods. Community organisations and relief agencies have developed a variety of urban planning strategies for strengthening social cohesion against the background of growing ethnic-cultural diversity. In line with the key objectives of the “Sendai Framework for Disaster Risk Reduction”, their implementation is intended to generally reduce the vulnerability of particular social groups (e.g. in the context of migration, social disadvantage, etc.) and to stimulate community resilience by encouraging residents to achieve a more sociable life in their respective socio-spatial environments. The presentation will introduce initial findings from the German research project ResOrt (Resilience through social cohesion – The role of organisations). Theoretically rooted in Robert J. Sampson’s “collective efficacy” approach and adapted from an extensive review of policy papers and practical guidelines the presentation will be based on guided interviews with experts from a broad variety of organisations in the fields of district development and community work. The focus of the presentation will be a practice-oriented model comprising different dimensions and interdependences of social cohesion and community resilience, proposing future directions of supporting urban planning in the face of crises and rapid social change.

Keywords: urban planning; social cohesion; collective efficacy; community resilience; ethnic heterogeneity.

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## Community local knowledge for flood risk management and external stakeholders: experiences from Malawi

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Local knowledge (LK) for disaster risk reduction (DRR) is increasingly seen as one of the keys to increased community resilience to various hazards. In the developing world, non-governmental organisations (NGOs) and local governments, together with other stakeholders, are involved in the process of community-based disaster risk reduction (CB-DRR), based on the underlying idea of fostering the participation of vulnerable populations, putting them at the centre of risk reduction activities, and integrating LK. However, participation and integration of LK often stay a mere ‘tick box’ exercise, and LK is often side-lined. With the majority of studies focused on documentation of the vast array of LK available within communities, understanding of how this knowledge is being used and perceived by external stakeholders (i.e. NGOs and local governments), working with rural communities, is limited. The aim of this study is to provide deeper insights into how NGOs and local governments view and account for LK, by focusing on flood risk management (FRM) in the Lower Shire Valley, the most vulnerable region affected by annual flooding in Malawi. Through a thematic analysis of key informant interviews (n=39) and focus group discussions (n=3), with local government and NGOs working in the Lower Shire Valley, this study explores the role of LK in existing CB-DRR projects. Consulted external stakeholders show a high level of awareness of the importance of LK for FRM at local levels. However, the understanding of LK is limited to the application of traditional early warning systems (e.g. ecological and meteorological early warning indicators), hence leaving LK underused for mitigation, response and recovery (e.g. traditional communities’ construction practices, traditional evacuation means). A number of perceived benefits of LK were reported, most significantly the increased sustainability of community-based projects where knowledge is taken on-board. However, examples of the explicit use of LK in community-based projects remain scarce. Participants indicated that LK is used during the participatory exercises, is included in the Village Contingency Plans, and local materials and workforce are commonly employed during project implementation. Community participation, and access to local-level information about LK, is primarily facilitated through the inclusion of Village Civil Protection Committees (VCPCs), thus providing a limited opportunity for knowledge sharing to individual community members. Results show that the level of confidence in LK is quite low, due to a lack of documentation, knowledge sharing and a repeatedly mentioned need for ‘validation’ with conventional scientific methods. Participants from NGOs and government perceive that LK is disappearing. However, one of the inherent characteristics of LK is its’ constantly evolving nature, and this study argues that LK is evolving rather than disappearing. The findings of this research show that LK, despite being seen as a valuable resource by external stakeholders, is currently underutilised in FRM. There is an apparent need for local level action in which external stakeholders, together with local communities, will be involved in the process of LK documentation. Furthermore, documented knowledge needs to be tested in real-time conditions, in order to be further employed in practical and policy-making approaches at local levels.

Keywords: local knowledge; participation; community-based disaster risk reduction; NGOs; local government.

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## Examining the efficacy of community participation in hazard mapping for Disaster Risk Reduction

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A core issue in the operationalization of disaster risk reduction efforts is the ability to empirically define disaster risk. While the Sendai Framework has called for the inclusion and mainstream use of risk maps (UNISDR 2015 sec. 24), there continues to be tension over sources of the knowledge used to inform such assessments. Gaillard and Mercer (2013) adeptly term this a ‘battlefield of knowledge and action.’ This research seeks to deepen our understanding of knowledge used to define spatial hazard exposure through a comparison of individual household, collective community, and scientifically based hazard assessments. Fundamentally, this study seeks to examine the efficacy of community participation in local hazard assessments. The following two hypotheses are tested: (1) household, collective community, and scientifically-based hazard assessments produce the same level of hazard exposure; (2) household and collective community hazard exposure assessments more accurately predict actual hazard events than scientific-based sources. This study draws from participatory action research conducted in partnership with the local government unit (LGU) of Carigara in the province of Leyte in the Philippines. As part of a six-month hazard mapping project led by the Municipal Disaster Risk Reduction and Management Office (MDRRMO), 427 individuals from across 49 constituent barangays were engaged in workshops to produce localized hazard maps. These community-based hazard maps built upon earlier scientifically-based maps produced by the Philippine Department of Science and Technology (DOST). Baseline survey data prior to the production of local hazard maps was collected from 2,162 households – an approximately 20 percent sample of the total municipal population. Survey questions asked households to assess their hazard exposure (low, medium, high, or no exposure) for landslides, storm surge, and flooding. Using InaSAFE software, a GIS hazard scenario analysis tool, exposure levels were computed for all surveyed households using DOST and community produced hazards maps. Paired t-tests were then used to compare (1) individual household hazard assessments; (2) community hazard assessments developed through workshop activities and; (3) scientific hazard assessments developed by DOST. Further, one case community was examined to explore hazard exposure for one hazard, flooding, during Tropical Storm Basyang in February 2018. Findings reveal that local knowledge from households and collective community assessments frequently assigned higher hazard exposure to settlement areas compared to scientifically-based maps, but often omitted exposure entirely for less populated regions. Local knowledge sources were found to be a more accurate predictor of actual exposure for populated areas, however scientifically-based assessments had significantly higher coverage for less frequent hazards, such as storm surge and landslides. Foremost, the findings of this study demonstrate the need to triangulate sources of knowledge for hazard assessments. Communities were unable to assess exposure for low probability, high impact events. Practically, while community participation is a more accurate predictor of local disaster risk, local knowledge, like scientific knowledge, has limits on its efficacy. Rather than view knowledge as dichotomous, there is a need to further explore integration strategies.

Keywords: community participation; local knowledge; hazard mapping.

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## Whose resilience, whose knowledge? Cognitive (in)justice in Disaster Risk Reduction education

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The call for resilience building through the Hyogo Framework for Action and the Sendai Framework for Disaster Risk Reduction prompted a worldwide response of mainstreaming Disaster Risk Reduction (DRR) learning in school curricula as well as in non-formal and informal channels of education by government and non-state actors. While there have been varying levels of response, less known are the effects of aligning local hazards and disaster learning practices with the dominant features of mainstream DRR education policy. To date, the literature on DRR education typically revolves around national policy studies and their implementation at the school level. Indeed, there had been less attention afforded to the issue of cognitive justice, specifically the impact of mainstreaming to local epistemologies and to peoples' culturally adaptive practices to hazards and disasters. Elsewhere, the issue of cognitive justice has spurred a long-running debate in disaster research. There is a critical collective asserting for indigenous and place-based knowledge to be given due emphasis alongside a largely techno-scientific approach to hazards management. The critique is specifically directed at international development projects aimed at mitigating the impact of hazards through interventionist means, negating the value and usefulness of local peoples' existing hazards management practices. This paper discusses the politics of knowledge construction in DRR education by answering this key research question: How do different actors and institutions employ place-based knowledge for risk reduction in K-12 formal, informal, and non-formal education, in places that are perennially exposed to cyclones (e.g., Western Australia, Vanuatu) or typhoons (e.g., the Philippines)? The analysis critically examines the framing of the concept of resilience and knowledge building for DRR education by focusing the discussion on how communities and institutions localise global approaches in responding to the call for building resilient communities. It then zeroes-in on how education stakeholders unevenly regard different knowledge systems in teaching about hydro-meteorological hazards and disasters. The paper also problematizes the singular framing of resilience by providing examples of how cyclones-exposed individuals and communities understand, learn, and live with recurrent hazards, identifying areas of disjoints as well as opportunities for improvement in the policy-practice nexus of DRR education. Ultimately, the author provides their insights on the features of an equitable and effective DRR learning – a valuable resource in disaster education governance at the local, national, and international levels. Data for this presentation comes from the author's fieldwork in cyclones-exposed communities of Western Australia, the Philippines, and Vanuatu. The methodological strategy involves ethnographic techniques in conjunction with layered data collection methods that include the following: qualitative content analysis, key informant interviews, and participant observation.

**Keywords:** disaster risk reduction (DRR) education, knowledge systems, cognitive justice, comparative education, resilience.

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## Increasing community resilience through community-based disaster risk management in Honduras

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The Swiss Red Cross is implementing a community based disaster risk management (CBDRM) program in Olancho, Honduras. It aims to strengthen disaster resilience among vulnerable communities. The program started in 2005 after several emergency and relief operations. Currently the program is implemented in three municipalities (Catacamas, Dulce Nombre de Culmí, and San Esteban). Applying a community-based approach, community committees are organized, trained, equipped, brought to official recognition and linked to the national disaster management system. Prevention and disaster risk mitigation builds on risk studies (including geological, hydrological, geomorphological and meteorological), complemented with traditional risk knowledge and coping mechanisms of the communities. Based on this combined knowledge, prevention and mitigation measures are defined, prioritized and established in a participatory way. Capacity building also takes place at the level of local authorities. The risk studies serve as an instrument for risk oriented decision making and are officially recognized and integrated in the municipal development and investment plans. The objective of this study was to understand whether community-based disaster risk measures, such as soil-bioengineering contribute to strengthen community resilience in disaster prone areas. The main research question was what extent do community-based soil-bioengineering techniques allow for effective mitigation of landslide events in the study area considering technical, environmental and social criteria for evaluating overall sustainability of this approach? The study has been conducted in 31 communities in the Olancho district in Honduras. In addition to the data collected through surveys and 10 semi-structured expert interviews in February/March 2018, this study draws on data collected by the staff of the Swiss and Honduran Red Cross on a continuous basis since the inception of their activities in 2005. Between 2015 and 2017, 157 slope stabilization sites were established based on soil bioengineering measures. An assessment of the established sites in 2018 showed: 1) 100% of the sites are regenerating very well; 2) 95% of the landowners maintain their sites well and; 3) 75% of the sites fulfil their function of soil stabilization. The socio-economic data show that the systematic development of the collaboration with the communities has had a decisive influence on the success rate of the concrete disaster risk reduction measures. Key elements of building this relationship used by the Swiss and Honduran Red Cross are the following: long-term project duration (contact with the communities over 5-10 years), participative and inclusive mapping and analysis of vulnerabilities and capacities in each community, establishment of community disaster management committees, regular visits to the communities, reliable delivery of promised services requiring also a contribution (planting material and labor) from the community. This has led to a high level of trust and commitment from the communities. Several landowners of stabilized sites used the expression “A situation of risk turned into a situation of opportunity” because the benefits do not only consist in soil stabilization but also provide the opportunity to plant and sell medicinal herbs, fuelwood, vegetables and fruits. The Swiss Red Cross will strengthen its promotion and implementation of community-based mitigation and soil-bioengineering, in terms of i) providing conceptual support and capacity building through learning events and; ii) give a stronger focus to community-based mitigation and “green” measures in the policy dialogue.

Keywords: community-based approaches, disaster risk reduction, soil bioengineering, Swiss Red Cross, Honduras.

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# Collective adaptation, social capital and self-organization of urban and peri-urban coastal communities on Java

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The low-lying coastal areas of northern Java are prone to an interplay of natural and human-made hazards. A slowly emerging absolute sea-level rise is enhanced by land subsidence up to -19 cm/a in some urban areas, due to excessive groundwater extraction and massive surface loads. As a consequence, the local population is exposed to frequent tidal and river floods. How are people able to maintain their livelihood in these multi-risk environments? Our study focuses on bottom-up strategies of households along the north coast of Java, namely the megacity of Jakarta, the regional urban center of Semarang and peri-urban villages in Kendal and Demak. We apply a mixed-method approach including focus-group discussions, key-informant interviews and a quantitative household survey (n = 950). Our results indicate that local people so far have been able to accommodate their multi-risk environment. Rather surprisingly, out-migration from these areas is marginal. Rather than retreating or gaining permanent structural protection, people have found ways to live with floods and subsidence. Coastal hazards have become a 'usual' experience and are not perceived as 'risks'. We found that strong social capital and a high level of self-organization are key factors in enabling the local communities to maintain their livelihoods, e.g. by creating informal insurance systems and networks of mutual help. Collective action and mutual neighborhood support are deeply embedded in people's daily routines. These habits have become one of the most important non-physical risk reduction practices. However, social relations in the study areas are mostly inward-looking and favoring the formation of bonding ties between community members. While social capital enables local people to cope with coastal hazards, long-term and innovative adaptation is constrained by lacking bridging and linking ties to the outside world, connecting local households to communities and stakeholders from other areas or from other parts of society. Our paper aims to discuss how the identified bottom-up approaches can be aligned with top-down strategies to increase the adaptive capacity of local communities and to open up new pathways for coastal hazard management. It seems to be particularly important to sustain neighborhood cohesions in relocation programs and to provide spaces of opportunities that enhance social interaction between different neighborhoods for developing bridging ties. In this way, existing coping capacities are preserved and long-term adaptation can be improved.

Keywords: coastal hazards, adaptation, social capital, hazard management, Indonesia.

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## Disaster activities to approach non-participants in disaster trainings and promote cooperation among local actors

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One of the big problems for enhancing community resilience in urban areas in Japan is that participants in community-based activities for disaster risk reduction (DRR) are the same every year and the majority of residents especially the young tend not to get engaged. As they are non-participants, effects of the activities for raising disaster awareness cannot reach them. Moreover, conventional disaster activities tend not to consider who stay in local communities when disasters occur. Especially in satellite cities, officers work in different cities and take time to go home without public transportation, even if they can, in large scale disaster occurring. They are local students, housewives, and local business owners and workers who could be the first responders at the local community in daytime on weekdays. The author and his seminar students attempted to overcome these challenges by holding or joining activities targeting small kids often followed by their parents. In the activities, we could approach the young parents who are not usually engaged in community activities, while raising disaster awareness of the small kids as future generation of resilience through playing games by understanding what would happen after disasters and what to do before and during the disaster situations. To do so effectively, the games are based on some education theories such as Action Learning modified by the author to attain better outcomes in a short period such as for 10-15 minutes. One of the characteristics of our activities is to hold them with local commercial organizations such as Junior Chamber International whose members usually stay at the local areas in daytime on weekdays, or to join festivals for general citizens held by a university with cooperation from a local government. The former activities could be catalysts for further cooperation among the actors who could respond together in daytime on weekdays, while the latter festivals would attract more residents so that the activities could approach more kids and their parents. This paper shows the activities above held in a satellite city in Japan and demonstrates outputs of the activities with a focus on finding statistically significant effects of disaster education on kids and difference in the parents' participation than conventional disaster trainings and poses challenges in the activities for further cooperation among local actors. Introducing these activities and their lessons would be beneficial as basic information for promoting preparedness not only by individual actors but also cooperative preparedness among actors, as prescribed in the item of (i) to promote the cooperation of diverse institutions in the Priority 4 of the Sendai Framework for Disaster Risk Reduction 2015-2030.

Keywords: cooperation; local actor; disaster activity; small kids; young parents.

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## Multiplying spaces of community empowerment and resilience

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This paper focuses on the challenges that contemporary informal Mexican communities are experiencing in the face of new trends and processes linked to neoliberal policies and its associated social conflicts and risks. The current battles for territorial governability, multicultural diversity, rapid growth and change, are part of everyday challenges along to filling basic infrastructure demands. In these conditions, the meaning of concepts such as sustainability and resilience require reconceptualising, in ways that not reliant on conventional western approaches. In particular, the concept of resilience, understood to mean constructive adaptation to risk (Folke et al 2002), is often merely an ideological concept meant to transfer responsibility for confronting serious problems generated by the effect of neoliberal policies onto communities and individuals, despite the fact that the responsibility lies with larger macro-economic institutions and corporations (Puyana and Romero 2006; Stiglitz 2002, 2006). This paper examines the tensions produced when such concepts come to conflict with local urban communities, values, capacities, and the priorities of actors and institutions' territories of the Global South. In specific, informal and marginal territories (where the majority of working force of the population lives) are challenged to fight everyday struggle. It argues that different conditions in the Global South demand an alternative understanding of sustainability and resilience, which are otherwise Western concepts, that can and should be redefined by local concerns. The central argument here is that adaption to the 'invisible' and transformative forces of neoliberal stage in Mexico, is more likely to take the form of resistance through collective action, which in fact may help to generate resilience. To explore this claim, this paper focuses on conditions of Altos de San Pablo case study at the Mexican State of Queretaro and the ways that Taller Activo, a locally based NGO, centered in traditional social cohesion of this community has been developing an acupuncture approach alongside a traditional formal legal framework for dealing with struggle. Taller Activo NGO identified the community of "La Esperanza", as a place where a group between 150 and 200 people, gathered every wedge day for community purposes. In the face of state failures to accommodate their demands, namely to reduce marginalization, Taller Activo visualized this as an opportunity to empower citizen around its demands. This paper thus provides one example of how collective action can be replicated in a local community and tries to make sense of how it can be expanded as a wider range of communities with multiple operations. In this sense, the research question is: if alternative architectural practices such as Taller Activo, could generate projects that are not only filling the infrastructure and facilities gaps, but to support and multiply inherent communities' capacity of self-organization, and self-determination and self-empowerment as a resilience concept redefined by local concerns.

Keywords: Global South; community; action; empowerment and resilience.

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## Developing flood risk reduction programmes through community risk mapping in Sudan

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Floods in Sudan have a significant impact on the most vulnerable people. Drowning is a major cause of death during floods and other water-related disasters. In Sudan, flood response and safety interventions in flood-prone areas are minimal. Government officials do not provide sufficient human or financial resources to implement comprehensive flood risk reduction programmes at a community level. This leaves a void which local communities and the NGO sector seek to fill. Nile Swimmers have worked with UNICEF to deliver a phased Community Flood Risk Analysis programme in targeted communities in White Nile State and West Kordofan State. The aim was to collect qualitative data to enable Nile Swimmers to design and develop community-based flood risk reduction interventions targeted at the most vulnerable populations in selected flood-prone areas. The second phase of the programme is to pilot the delivery of flood risk reduction interventions in the targeted communities. Nile Swimmers develops community-level water safety interventions using a risk-based approach. The organisation specialises in carrying out flood risk assessments and risk mapping exercises using the participatory approaches of the Drowning Risk Assessment Toolkit (DRAT). The objective of DRAT is to enable communities to understand water safety risks in their daily lives and the impacts of these risks. The flooding experienced in Sudan in 2017 caused limited damage in communities compared to previous years. This led to a wider range of responses on the effects of flooding beyond loss of life and damage to property. Issues that were highlighted repeatedly included: lack of access to safe drinking water (for both humans & animals); insufficient infrastructure and transport links to access services (such as healthcare & education); and inadequate local skills to provide a “first responder” level of basic emergency medical care to the community. The issues raised are all exacerbated by the impact of flooding. However, they are all problems that communities continually face in daily life. To build local resilience to flooding in these communities, the second phase of the programme must be responsive to the identified local needs. The package of interventions to be delivered needs to encompass: drowning prevention education; water, sanitation and hygiene; and first responder training. This presentation will discuss the challenges and successes of delivering a community led risk mapping project in Sudan, present the results of the first phase of the study, and provide updates on the progress of the pilot projects in the second phase. Ongoing monitoring of communities is required to fully understand the impact of these interventions on community resilience to future flooding disasters.

**Keywords:** flood risk assessment, community resilience, vulnerable communities, Drowning Risk Assessment Toolkit (DRAT).

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## TRACK 3J

### DRR as a professional competency for construction practitioners

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## Improving Disaster Risk Reduction education for Australian construction professionals

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There is an increasing push from governments and agencies around the world to mainstream Disaster Risk Reduction (DRR) in professional practice. The built environment is a major stakeholder when it comes to DRR, and the associated construction professionals have a responsibility to help mainstream DRR within the built environment profession. This research paper examines how DRR practices and knowledge can best be disseminated among construction professionals, by first identifying gaps in the current curriculum. We identify the core DRR knowledge, skills and requirements and determine if the current Construction Management (CM) programs in New South Wales, Australia, include these within their degree programs. This includes a study of the current DRR literature focusing on three main themes including DRR, DRR within the built environment and construction professionals. This research paper adopted a qualitative research method involving a three phased approach including a systematic literature review, assessment of current CM Curriculum and a gap analysis study of the results of Phase 1 and Phase 2. As part of the research method a thematic analysis was conducted on a database of documents relating to the key themes of this research. As a result of this eleven core DRR knowledge, skills and requirements were identified as important to construction professionals engaging with DRR. The curriculum of four major universities within New South Wales were examined and it was found that only six out of the eleven core DRR knowledge, skills and requirements were covered within the current CM curriculum. As such, three major recommendations have been produced as a result of this research providing guidance to the bodies responsible on how to better disseminate the core DRR knowledge, skills and requirements within the CM related degree programs. The results of this study have found that more needs to be done in relation to the implementation of the core DRR knowledge, skills and requirements within the CM curriculum. There is an opportunity to carry out further research in this area by assessing the CM curriculum across all of Australia and around the world. A longitudinal study is recommended to assess the success of mainstreaming DRR with CM Curriculum and also to assess the success and or failure of the recommendations made within this research paper.

Keywords: disaster risk reduction; construction practitioners; curriculum; mainstreaming.

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## Are architects up to the challenge of mitigating risks through design? Some impressions from the field

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Disaster risk management, in all its stages, clearly has an interdisciplinary nature; indeed, several disciplines are called upon to contribute to comprehensively appraise, characterize, manage and communicate risks. The same reasoning is valid within disaster management per se, which deals with risks materialized into undesired large-scale damaging situations. Since the 2004 tsunami in the Indian Ocean, architects have increasingly been integrating the sphere of humanitarian practitioners in emergency situations, being involved in the relief and recovery phases in the aftermath of great disasters. It is somehow assumed that the process of building back better the affected territories can be supported by some of the competencies developed within the training of these ‘humanitarian architects’. But what about the opposite (and more proactive) pole of the risk cycle? To what extent is the risk-mitigation agenda within DRM – that is, building to face and minimize risks from the start – being internalized by design activities? This paper examines the role of architectural practices in incorporating risk mitigation and adaptation within their day-to-day design activities. It draws on the conclusions of a research focusing on the design of flood-prone urban projects in Europe, within which we had the opportunity to interview 22 designers involved in this kind of projects. The paper is structured around some key concepts that underlie the interviewees’ statements about dealing with floods through design, explored through content analysis. Having very different experiences with flood-related projects, these stakeholders showed uneven degrees of sensitivity to manage risks through design. While some of them still view flood-risk management as a technical issue to be dealt with mostly by engineers through structural measures (therefore outside the scope of their architectural practices), others take risk mitigation and adaptation as actual threads to formulate their overall design decisions. Our analyses of these testimonies pinpoint that in order for architects to be up to the challenge of mitigating risks through design some crucial ingredients are needed, such as high risk awareness, understanding risk processes, professional openness (to actually perform collaborative works within interdisciplinary design teams) and a positive mindset. These factors may help architects face risks since the beginning of the design process (instead of as a mere secondary layer added later on to their projects) and therefore contribute more effectively to disaster-risk-reduction endeavours.

**Keywords:** disaster risk mitigation through design; architectural practices; flood adaptation; professional competencies; design process.

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## A perception and spatial study on the effects of facilities in evacuation sites in a tsunami-prone environment

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Nowadays, the characteristic of evacuation sites – urban design and spatial location – are defined without considering local needs. This is the case in Chile, where evacuation sites in case of tsunami lack of emergency facilities, causing problems for the community at the moment of an evacuation. The purpose here is to evaluate if the presence of emergency facilities and the spatial distribution of evacuation sites makes a difference on how people perceive them and in turn, in the process of evacuation from tsunami hazard. Participants (N=78) of four villages along the Chilean coast evaluated a set of natural and built images of evacuation sites. Images of natural sites were manipulated in Photoshop to include emergency infrastructure (e.g. shelter and water); hence, three types of site categories were evaluated; natural sites, built sites, and intervened sites. A 1 to 5 Likert scale was used for the evaluation of images in terms of perceived security (SE), place attachment (ATT) and restoration (RES). By using descriptive statistics, we explored if the presence of emergency facilities affects perception, finding a predisposition to perceive greater security (SE), attachment (ATT) and restoration (RES) in natural (SE=2.1, ATT=1.9, RES=2.0) and intervened sites (SE=2.4, ATT=2.1; RES=2.3), over built sites (SE=1.9, ATT=1.6, RES=1.6). To further explore the effect of the spatial distribution of sites in perception, a spatial regression analysis was performed in GIS using two geographic regression models: One with images of the natural and built sites (NB) which represents the villages as they are today; and another model with images of the intervened and built sites (IB) which represents the villages with emergency infrastructure. In the NB model, perceived security was explained by the height (to sea level) and the average distance to natural places ( $R^2=0.51$ ), while in the IB model only the height ( $R^2=0.53$ ) explains the greater perceived security. It is possible that the presence of emergency infrastructure in the IB model satisfies people's needs after disaster (e.g. water), which otherwise, people look for in natural areas as in the NB model. With respect to perceived attachment, only the height explains the results in the NB model ( $R^2=0.43$ ), while in the IB model the height, the distance to coastline and average distance between natural sites explain greater attachment ( $R^2=0.71$ ). Place attachment refers to the bonds that arise between people and sites; according to these results, the incorporation of emergency infrastructure in the evacuation sites should be facilitated in places near the coast and natural places to favor attachment. In relation to restoration, the distance to the coastline and the average distance between natural sites explain the highest restoration perceived in both models (NB  $R^2=0.51$ ; IB  $R^2=0.63$ ). Restoration, or the capacity of sites to recover physiological and psychological needs lost due to external pressures, is not conditioned by emergency infrastructure. Planners should take into consideration that the incorporation of emergency facilities in evacuation sites can improve evacuation processes in case of tsunami; however, these findings are mediated by the spatial location of sites.

Keywords: Evacuation sites; tsunami; perception; spatial analysis.

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## Emergency healthcare network in Santiago, Chile: a model of seismic vulnerability and functional interdependencies for assessment of earthquake risk and resilience

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In large earthquake scenarios, the urban population is directly affected by physical damages to buildings and structures, which may induce casualties and result in the loss of homes and income sources, but also by the reduced access to key services like health care, transportation, water and power supply. Hence, the overall resilience of urban regions is significantly determined by the capability of critical networks to sustain functionality, cope and recover from losses generated by extreme events, including structural and non-structural damage to facilities, discontinuity of different supply chains, and absence of essential personnel. This work is part of the project “SIBER-RISK: SIMulation Based Earthquake Risk and Resilience of Interdependent Systems and NetworKs”, which will develop an integrated framework for the study of seismic risk and resilience of three geographically distributed and complex systems deployed in Central Chile: the transportation, healthcare, and electricity networks. Here, we focus on the emergency healthcare network (EHN) in metropolitan Santiago de Chile, a city of roughly seven million inhabitants located in a region potentially affected by megathrust earthquakes in the Nazca-South America subduction zone, or by events generated in the San Ramón fault. The goal is to provide a physical and functional model of the EHN that allows simulation and quantification of earthquake risk and resilience metrics, considering both internal dependencies and links to other critical infrastructure. The metropolitan Santiago emergency healthcare network is a mixed system, composed of 75 private clinics and 152 public facilities, of which 45 are hospitals of varying complexity levels, and 107 are primary healthcare attention centers (PHACs). Administration of public facilities is split among six different Health Services, sub-agencies of the Ministry of Health (MINSAL) that are responsible for health services delivery in specific geographical areas and for actions related to health promotion, protection, and recovery in their territories. To model the composite vulnerability of this complex network to seismic hazards, we have compiled a large body of public information and databases, carried out remote visual surveys and field observation campaigns of different elements of the networks, and conducted several interviews to relevant actors of MINSAL and its operational units. In this way, we have constructed a physical network model including structural non-structural parameters of individual facilities, so as to characterize their seismic fragility and estimate the expected degree of damage and downtime as a function of earthquake intensity measures. Additionally, we have mapped the operational relations between emergency healthcare facilities, which are connected through patient referrals and cross-referrals, depending on the specialty and the demand for services. The resulting physical and functional models are then integrated into a discrete event simulation, thus codifying the behaviour of the Santiago healthcare network as an ordered sequence of well-defined events with calibrated durations and demand. In the event of a large earthquake, the demand, duration and sequence of such events will be disrupted, as predicted by physical and social loss estimation platforms like for example HAZUS or OpenQuake. The discrete event simulation can then be altered accordingly to estimate the overall increase of patient waiting times, and thus analyze the effects of given earthquake scenarios on the performance of the health care network within the probabilistic risk and resilience framework.

Keywords: earthquake, network, healthcare, risk, resilience.

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## Disaster Risk Reduction improvement suggestions for a renewal area in Istanbul

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Cities need transformation, improvement and renewal over time due to economic and social reasons as well as disasters. Urban regeneration is applied all over the world to meet different needs of cities. Like many, Istanbul also faces urban regeneration practices since 1980s on illegal or unhealthy areas. After the Marmara Earthquake in 1999, the Turkish government has intended to take precautions against disaster risk in the built environment. One way to implement the new strategy is to renew old buildings in order to provide earthquake safety. Renewal became the main type of urban regeneration implemented in the country. Renewal on building scale is very common, so much so that even though they are single practices, they have urban-scale effects due to their high numbers. On the other hand, three major causes for losses from disasters in Turkey are earthquakes, landslides and flood events. 66 percent of country's lands are located in the 1<sup>st</sup> and 2<sup>nd</sup> degree earthquake zones. A major earthquake is highly anticipated in regions where 70 percent of the whole country's population reside and in industrial areas where 75 percent of large industrial plants have been established. Despite these possible disasters, disaster management is still premature in Turkey. There are gaps in legislations related to the subject, lack of correct organization plans for management and lack of consideration of different approaches. The lack of adequate scientific work has created problems in the creation and development of disaster culture in the community. Urban renewal in Istanbul is an opportunity to implement all the missing aspects of disaster management plans since many buildings are being rebuild. It is important to take the steps to identify the deficiencies and to fill the gaps in management in order to reduce disaster risks in the new built environment. Disaster risk reduction practice reduces disaster risks by analyzing impacts of disasters. In order to successfully carry out the risk mitigation under the disaster management, the current situation needs to be analyzed in detail. In this study, it is aimed to establish Strengths, Weaknesses, Opportunities, Threats (SWOT) analysis in the selected field and to develop disaster risk reduction recommendations according to the conducted analysis. A neighborhood of Kadıköy district in Istanbul is analyzed as fieldwork due to its central location and numerous practices of building renewals in the area. The SWOT analysis based on institutional, physical and social issues reveals that there are gaps in the legal framework, risks arise in the physical environment and there are social groups which require special attention in disaster management plans. The findings of the research highlight the importance of local analyses for identifying disaster risks and verify the need for disaster risk reduction improvement at local levels.

Keywords: disaster risk reduction; SWOT analysis; urban renewal.

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## TRACK 3K

### Impact of migration: reducing risk and resilience in humanitarian disaster through sustainable practice

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# Beyond the threshold: an approach to execute existing humanitarian disaster in vulnerable forcefully displaced Myanmar citizens (Rohingya refugee) camp with the potential environmental risks in Bangladesh

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The purpose of this paper is to focus on the magnitude of humanitarian crisis in vulnerable Rohingya Refugee Camp and the potential environmental risks finding which can be foreseen in hilly territory of Bangladesh because of this crisis. More than a million of Rohingya refugees have crossed into Bangladesh fleeing from the brutality of Myanmar Army since 2015. Denoted as “Ethnic Cleansing” by UN officials, this vulnerable Rohingya migrant has created a humanitarian crisis along with risks for the environment of the hilly territory, which is yet to be uncharted to the world. The paper will focus on the brief narration of mass gang-rape, genocide, fierce beating, human trafficking and the violation of other human rights which are faced by vulnerable Rohingya migrants. This paper will also disclose the aftermath of Rohingya migration with other humanitarian crisis of refugee shelter, health, rural fabric, ecological and demographic diversion of the hilly territory of Bangladesh. Moreover, to spotlight those sensitive humanitarian issues inside existing the Rohingya Refugee Camp along with the environmental risks because of this huge migration in the southern hilly area of Bangladesh will be executed in broader aspects throughout the anecdote of this paper.

Keywords: Rohingya refugee, genocide, human trafficking, humanitarian crisis, seasonal crisis.

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## Exploration of the impact on environment and land use in case of Rohingya influx in Bangladesh: guideline for sustainable survival

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Myanmar, as situated at the south-western direction of Bangladesh, is a country which contains about one third minority group of people in comparison to the total population. Rakhine Muslims (known as ‘Rohingya’) people are one of the seven minorities of the country. Because of huge cultural and religious difference in many aspects, the Muslims are overlooked by the Government of Myanmar since 1982. As the aftermath of ‘Ethnic Cleansing’ in Myanmar, a huge number of (approximately 607,000 within August, 2017 to October, 2017) Rohingya people have taken shelter in Teknaf, Ukhiya, Bandarban areas in Bangladesh. This influx has caused a humanitarian crisis and since this large number of people cannot be returned for humanitarian reasons, the Government of Bangladesh is making effort to accommodate these people for short time period. But Bangladesh is paying high price for Rohingya influx and the attempt to accommodate this large number of people. The negative impacts include environmental and spatial concerns as well as social and economic issues. The area where the displaced citizens of Myanmar are living in is being imposed of a rise in temperature and change in land-use pattern. Because of deforestation and cutting hills is causing a drastic change in land use. This change is affecting environmental degradation too. The goal of this study is to explore the amount of environmental degradation focusing on the temperature rise and the land use before and after Rohingya influx comparing between the Rohingya camp and surrounding areas. The methodology includes quantitative and qualitative research methods. After selecting the site, time selection, weather temperature readings have been used from secondary data collection. The outcome of the research would answer the queries about the negative impacts on the climate of the focused area because of Rohingya influx, the spatial impacts on land use pattern and how the effects can be minimized by architectural interventions through the practice of sustainability.

Keywords: environment, land use, Rohingya influx, sustainable survival.

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## Exploration of the transformation of shelters of the displaced citizens of Myanmar in Bangladesh

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'Rohingya Influx', as one of the most alarming humanitarian disasters in recent world, is creating a worse situation day by day. Bangladesh makes effort to accommodate the huge number of Rohingya people coming from Myanmar from humanitarian point of view. Before this massive influx, Bangladesh has been facing illegal influx and land encroachment by Rohingyas from a very long time. These people are cutting hills to create their spaces to live with temporary materials first, and then transform these spaces sequentially, somehow by encroaching, and to then shelter new Rohingya people coming from Myanmar. They are transforming not only the place they are living, but also their identity and nationality by the owned lands in Bangladesh, which is alarming and frightening too. The way they start their life here and the way they transform these spaces day by day are a matter of concern for the existing authority. This study aims to find the type of their settling spaces and the process of progressing the transformation of the abiding spaces. To identify the phasing steps of the shelters they use is the outcome of this research. The methodology includes both quantitative and qualitative research methods. Observation, primary and secondary data, and drawing software are going to be used. Focus-group discussion, key-informant interviews, and in depth interview are done to get primary data. After selection of the site, simple random sampling method has been done to bring out the different case studies. Case study survey and questionnaire survey were done to study the details. The outcome focuses basically on the type of dwelling and the transformation process of the dwellings in Bangladesh by the displaced citizen of Myanmar.

Keywords: transformation, shelters, Rohingya influx, encroachment.

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## TRACK 3L

### The significance of gender for the creation of resilience and sustainability

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## Social capital and gender following disaster: the case of the El Morro community, Chile

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This paper examines the role of social capital in empowering women following a disaster. From a gender perspective, the three types of social capital, including bonding, bridging, and linking are analysed throughout the different stages of a disaster. The results of a quasi-ethnographic work and a seven-year longitudinal research carried out in a small-scale fishing community affected by the 2010 Chile earthquake and tsunami (through methods of semi-structured interviews, focus group, participatory observation, and documentary review), showed that women's social capital played a critical role in coping with and recovering from the disaster. Bonding, bridging and linking social capital can facilitate the mobilisation of women's resilience and their empowerment, increasing their chances of survival and recovery. Our study also showed that women's informal networks were useful in dealing with the short- and long-term consequences of the disaster. These findings can contribute to designing and implementing disaster management strategies that promote women's social capital and resilience in developing countries.

Keywords: gender, social capital, disaster, resilience, women.

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## Factors affecting the empowerment of women in disaster risk governance in Sri Lanka

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With rapid increase of natural hazards demands effective and efficient disaster risk reduction and resilience mechanisms to minimize their devastating results. Effects of natural hazards are diverse depending on the economic status, geographic location, and socio economic background of people as well as gender. Women have been disproportionately affected by any hazards due to their specific physical, social, cultural and economic vulnerabilities. In order to address this burning issue, leading international frameworks emphasises the importance of disaster risk governance in any disaster risk reduction strategy. Risk governance ensures participation of all relevant stakeholders for making decisions which affect themselves and the society. This ensures empowerment of women in disaster risk and resilience decision-making process. Despite this fact, evidences suggest that empowerment of women in risk governance is very low in many developing countries including Sri Lanka. Hence, the objective of this paper is to identify the factors that affect empowerment of women in disaster risk governance in Sri Lanka. This particular paper is based on a PhD study that aims to propose a framework to enhance empowerment of women in risk governance in Sri Lanka. Sri Lanka has been selected due to its frequent threats of natural hazards as well as status of women when compared to other countries in the region. The study conducted a detailed literature review to identify the factors that affect empowerment of women in decision-making. Based on the identified factors, an interview guideline was developed. Nine interviews were conducted during November 2017 with officials at the Disaster Management Centre, Asia Disaster Preparedness Centre, District Secretariat Offices, Divisional Secretariat Offices, District Disaster Management Coordination Units and academics. Data were analysed qualitatively and presented using content analysis. The study found that legal and institutional factors, individual characteristics, socio-cultural factors and socio-economic factors as the critical factors that affect women empowerment in disaster risk governance. Unfavourable political environment, lack of supporting policies and legislations, and patriarchal organization culture, categorized as legal and institutional factors, limit empowerment of women in risk governance. Two factors represent individual characteristics: low level of education and low self-interest hinders their level of empowerment. Patriarchal culture, strong religious believes, structure of the family and household workload are the sociocultural factors which affect their level of empowerment. Finally, household income also affects the level of empowerment among women since it is the main factor of socioeconomic condition. These results will be used to develop the intended framework as the next stage of the study. These outcomes would be valuable inputs for policy makers to address the issue of vulnerability among women as well as their resilience.

Keywords: disaster risk governance; disaster risk reduction; disaster risk; decision making; Sri Lanka.

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## Building capacity and developing community women leadership for disaster resilience in Fiji

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Worldwide disasters have a cumulative global impact, while the nature, characteristics and typology of disasters vary widely across regions and localities. Communities in Fiji, particularly in remote and rural locations, are highly vulnerable to hazards. Women in such contexts are usually embedded in their communities and have strong potential as community leaders to contribute to disaster resilience. This paper presents the outcomes of an action research project conducted in Fiji in 2017. The project focused on building capacity of Fijian women in disaster risk assessment, preparedness, response and recovery. The main objectives of the project were fourfold. The first objective was to consult with key local stakeholders in Fiji to ascertain capacity building needs, the corresponding form of training and the directions of the long-term outcomes of the training. Secondly, to develop a suitable and contextual ToT training package based on consultations with key stakeholders. Thirdly, to provide structured disaster resilience ToTs to local trainers nominated by stakeholder partners in Fiji. Finally, supporting trainers to run a training course for women community leaders in a remote/rural location and evaluate the training in the process. The team worked with key local stakeholders in Fiji to provide training-of-trainers (ToT) and support for empowering women leaders for disaster resilience. Beginning with a project planning workshop in Suva, a ToT on women and disaster resilience was then run in Nadi for stakeholders from key agencies in Fiji. A team of Fijian policewomen trainers who were trained at the ToT were then provided a training package and support to run a training course in Naboutini village. Initial assessment of the training undertaken in this pilot study was very encouraging, including positive feedback from the stakeholders involved and indication of a strong appetite for further training to be undertaken in the community. Future work will look to facilitate mechanisms for long-term assessment, quality assurance and sustenance of the capacity building initiative through local ownership.

Keywords: resilience; community participation; gender; disaster risk reduction; Fiji.

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## Female empowerment: requirements for design education

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Women are cultural bearers. As mothers and grandmothers they are transferring traditions to the next generation. They are also adapting the traditions to the current situation. They are furnishing the home with whatever means available, thereby working as lay designers. Thus, they have the ability to contribute to everyday resilience and a sustainable future, provided they are empowered with the tools and authority to do so. On the other hand, professional designers are often engaged in sustainability projects in cooperation with lay people, but lack competence in the significance of gender and are unaware of the specific female traditions. Additionally, they are also often negligent to their own gendered attitudes. This raises the question of how the topic of gender should be included in and linked to the matter of sustainability in design education. Just as important, there is the question of how one should become aware of and change the gendered attitudes among teachers and students. The aims of the investigation have been to find efficient ways to implement the topic of gender related to sustainability and resilience, and to uncover teachers' and students' attitudes and behaviour towards to gender. The investigation is a case study of the Department of Product Design at Oslo Met Oslo Metropolitan University (previously Oslo and Akershus University College of Applied Sciences). As this design education is quite similar to others, the outcome should be of international relevance. The analysis is based on data from the two events: a seminar for the teachers and a lecture for the master students, and a questionnaire that was sent to the participants. Oslo Met's implementation plans for diversity, governmental documents and scientific publications have also been examined. The investigation showed that some teachers, more males than females, found little or no relevance of the topic, and some males were reluctant to discuss the matter. Those who found it relevant meant that the topic should be integrated as early as possible, both at a general level and in courses related to design history, universal design, ergonomics, methodology, culture and aesthetics. The male teachers' answers to the questions were rather specific. The female teachers gave more value driven and sometimes vague comments, indicating that they had a low estimation of their own competence. Both males and females put forward harmony, likeness and consensus as ideals, while only a few mentioned the possibility of utilizing gender differences as a driving factor in the development of a sustainable future. There was generally a low awareness of the gender's significance for a sustainable development, and none of the role of women in particular. The answers from the students expressed the present situation in a nutshell: Teachers and students are still working within an outdated frame of reference. We are only partly aware of it, and reluctant to take up the question, due to its delicacy. They had no knowledge of the relevance for a sustainable development, which reflected their teachers' unconsciousness of it. As sustainability is already integrated in most courses, it should be easy to combine it with gender and female traditions. Improvement of competence in the field is highly required. The greatest challenge is to create awareness of the significance of the topic. Males must dare to confront and discuss it and to analyse own attitudes. Females should be empowered not only to speak, but to take action. They should also become more conscious of their own specific abilities as bearers of a female cultural tradition. The situation mirrors that of the areas where sustainability projects are performed and which future designers will meet when they take part in such projects.

Keywords: gendered attitudes; women; female culture; design education; sustainability.

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## Reducing the vulnerability of Antandroy women to drought (Madagascar)

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Drought is one of the most devastating disasters. It can last for months, even years. The consequences are the same, but the planning of disaster responses varies according to the financial, technical and human means possessed by the affected areas. The poorest countries or communities are the least resilient and struggle with the impact of drought. In Androy, in the south of Madagascar, drought reigns and handicaps the agriculture and livestock farming. The drought breeds famine and deteriorates the living conditions of the Antandroy people. Though, human vulnerability to a hazard differs according to age, sex, race, religion. The precariousness of the situation of the Antandroy women caused by drought pushed the choice of this study, whose main objective is to reduce the vulnerability of Antandroy women to drought. To carry out this study, the work has four parts which are: the methodological approach, the analyses of the current situation of Antandroy women, the research results and the discussion. To survive, Antandroy households have to sell their livestock at derisory prices. Men are often forced to migrate out of the Androy to find work. So, women became guardians of homes, and they are alone to face the harsh reality of life. As heads of their family, women get more responsibility than when they get their husband near them. Moreover, there are several factors that increase the vulnerability of these Antandroy women. It comes mainly from the low level of education, the discriminatory culture that disadvantages women's status, household size and poverty. Thus, the development of income-generating activities reduces exposure to drought. This includes the diversification of activities in different sectors, the use of varied seeds, the rational management of land and the environment such as the protection of the environment, the definitive eradication of the practice of slash-and-burn cultivation and bushfires. Compared to men, their vulnerability is more pronounced. That's the reason why, their resilience is important and should be reinforced. For example, the woman must be creative in order to survive her family, digging the river to find water, picking leaves and cactus fruits as food for her household. The determination of Antandroy women to improve their living conditions contributes to the reduction of their vulnerability to drought. Furthermore, campaigns on gender equality by the public administration and civil society are key to turning the situation of those women into a long-term one. In addition, the political will from the Malagasy government remains the major solution for the realization of water projects in the far south affected by the scarcity of water.

Keywords: vulnerability; drought; women's resilience; Androy.

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## ‘A walk with the lads’: masculinities’ perspectives, gender dynamics and resilience in Soacha, Colombia

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Soacha is a municipality in the periphery of Colombia’s capital Bogotá, whose population has soared over the past two decades with a constant influx of displaced people coming from different areas of conflict all over the country. This has created fragile, vulnerable and informal urban settings; categories which best describe 50% of the settlements in the municipality. High levels of tenure insecurity, territorial control by gangs, intra-urban displacement, and violence, a generalised lack of protection of the population, disenfranchisement and lack of rights set the backdrop of the daily lives of hundreds of thousands of people. Yet, in these most adverse circumstances, people have managed to create communities and, in spite of lack of support of any kind from local authorities, to build neighbourhoods which they can call ‘home’. As part of the Horizon 2020 project, ‘Preparedness and Resilience to address Urban Vulnerability’ (PRUV), which is aimed at reshaping the practice of humanitarian action and development aid in urban areas, we have carried a gender-segregated research in one specific locality, Altos de Florida. We have applied the Urban Vulnerability Walk methodology to understand the vulnerabilities of both men and women. This methodology was developed by Plan International and UN-Habitat in 2013 to explore the safety needs of adolescent girls in cities. Yet, when applied to men, it became evident that men were trying mostly to conceal their own vulnerabilities and use the walk to reinforce values – such as control – linked to the normative dimensions associated to the notion of hegemonic masculinity. However, this exercise also helped us understand important elements of gender dynamics and their contradictory relationship to the development of resilient practices among these communities. A similar research has been carried out in Nairobi (Kenya) and also in Jakarta (Indonesia). The results of these three experiences will be contrasted to understand the ways in which masculinities’ perspectives can help us get a better grasp at gender dynamics in different settings. We found that insecurity of tenure challenges the normative views on masculinity of men in these communities, which has massive implications not only to gender dynamics, but also to how people interact and work collectively in order to face the challenges posed by the vulnerable situation in which they find themselves. While the methodology was useful to identify vulnerabilities and risks, it proved equally useful to better understand the resources of the community, both of the women and the men, in order to overcome the difficulties in which they are immersed and to build a sustainable future.

Keywords: masculinities; insecure tenure; resilience; Colombia; urban vulnerability walk.

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## Disaster Risk Reduction in urban slums: empowering women in resilience measures

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In South Asia 34% of the population presently lives in urban areas. Overall it is expected that the urbanization rate in the whole region will reach 50% by 2026. Rapid urbanization and development go along with increasing disaster risks. A big segment of this population lives in slums or ghettos, and the numbers are expected to rise. This segment of urban population is at much higher risk in disasters due to inaccessibility to resources, increased poverty, non-regulated housing and lack of WASH facilities. These risks are further compounded for vulnerable groups such as women and children who are disproportionately underprivileged in terms of Human Development Indicators. A study based on empirical tools that included data from primary and secondary sources was conducted in the urban slums to understand the specific socio economic factors that contribute to the increased vulnerabilities of these women. The study also quantified their knowledge base and skill set to serve as a baseline to design interventions that mitigate their risks and equip them to respond proactively to disasters. Some of the socio economic factors identified through the study were; lack of education, informal work industry, religion, lack of economic empowerment and inadequate awareness on self-preservation measures. DRR and resilience is part and parcel of sustainable development in the environmental, economic, social and political spheres. It was understood that there was a need to integrate efforts towards SDGs, climate change adaptation and DRM in the urban slums in line with the Paris Agreement, ensuring consideration of pre-existing vulnerabilities and limited resources available to strengthen their resilience. Based on the output of this study, a disaster preparedness tool was developed with the aim to empower these women to not only mitigate their risks but to become effective responders in line with Sendai Framework Priority Areas 1 and 3. There was a conscious effort to steer clear of the pre-existing inequalities and ensuring that resilience was derived through initiatives that were community based and non-resource incentive specifically for the women in the slums who are extremely marginalized. The conclusion of this study led to development of resilience tool based on contextualized urban risk assessment with specific focus on women in urban slums; a high risk community but with little visibility and political weight. It was understood that hazards and risk in urban slums are predominantly human-induced, exacerbate natural events and affect women more than men. Various economic, social, and economic aspects further compound the risks that urban women face but resilience can be incorporated through simple solutions identified with the support of the local community and imbedding the same through education, religion and norms. This paper attempts to use the findings of this research to identify not only the contributing factors of increased vulnerabilities of these women in urban slums, but also provide a CBDRM-based solution that is effective in enhancing their resilience.

Keywords: urban slums, gender vulnerability, socio-cultural barriers, resilience, CBDRM.

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# Empowerment in the era of resilience building: a gendered appraisal of community-based disaster risk management among informal settlers in Metro Cebu, the Philippines

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As the economic, social and environmental impacts of climate change become increasingly apparent in the Philippines, so too is the prominence of disaster risk reduction and management (DRRM) in local and national development agendas. Within this landscape, community-based approaches have become the unquestioned orthodoxy, framed by narratives of participation, resilience and empowerment. Among urban poor informal settlers, state-endorsed disaster risk reduction interventions are often facilitated via homeowner associations, with Filipino women serving as critical drivers of grassroots action within these spaces. This paper interrogates the extent to which these community-based mobilisations are serving to address or exacerbate gendered inequalities that underpin vulnerabilities to risk. Drawing on extensive qualitative evidence collected over seven months of fieldwork between 2014 and 2017, I argue that grassroots ‘resilience-building’ and community-based DRRM are decidedly gendered in practice, highlighting how both the degree and nature of participation in these activities is shaped by gender stereotypes, perceptions and experiences. While grassroots ‘resilience building’ and community-based DRRM may thus be reinforcing rather than redressing existing gender inequalities and power differentials, participation in homeowner associations and associated risk management activities is also facilitating meaningful (albeit unintended) personal transformations among female members, that women themselves depict as a process of empowerment. These findings reinforce the importance of understanding the socio-spatial manifestations of gender roles, power and agency to the development of inclusive DRRM and resilience-building strategies.

Keywords: gender, slums, urban, community-based disaster risk management, empowerment.

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## Whose visions of the city? The challenge of inclusivity in rebuilding after disaster

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The devastation caused by some major disasters is so considerable that it necessitates the reconstruction of the physical and social fabric. Whose visions guide such reconstructions and what alternative visions might be applied? To what extent does, or could, the rethinking and rebuilding incorporate an overt and critical commitment to inclusivity across intersecting axes of gender and generation, race and ethnicity, abilities and vulnerabilities, and other spatial manifestations of power? This paper explores recently reconstructed cities (or parts of cities) from an intersectional perspective but with, for reasons of manageability, an initial primary focus on gender.

Keywords: gender; inclusivity; intersectionality; disaster reconstruction.

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## The gendered body politic in disaster policy and practice

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The field of gender and disasters emerged from the notion that a disaster is a physically and socially-constructed event. Recognition that women's position in society and the home created vulnerabilities to disasters has led to the development and application of gender in disaster policy and practise over the last two decades. Gender research has been important to ensure women's needs are recognised and assistance provided in an appropriate manner within disaster contexts. However, 'gender and disaster' has become synonymous with the interests and concerns of women due to structural inequalities in society that extend into the field of disaster management. Drawing on body politic within social and political theory, which discusses how men are considered the 'neutral', idealised gender, this paper considers how an inclusive understanding of gender and disasters may be developed through considering the strengths of and challenges for men. There have been limited analyses of the broader perceptions and experiences of men residing in communities impacted by disasters. Therefore, expanding this scholarship will provide a foundation for understanding men's stories and experiences of disaster.

Keywords: gender; disaster; women; men; DRR.

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## The 8<sup>th</sup> ICBR Lisbon 2018 publication outputs and the contributions of the Special Session and the thematic track on Gender and Resilience: Special Issues and Elsevier books

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The presentation focuses on the announcement of a Special Issue of an indexed journal that will be based on a selection of papers presented in the Special Session on Gender and Resilience and in the associated track. The conceptual and thematic framework will be discussed with regard to the 8<sup>th</sup> ICBR's motto – Risk and Resilience in Practice: Vulnerabilities, Displaced People, Local Communities and Heritages –, and taking into consideration the pieces of research submitted in each track. Also will be addressed the possible gaps in the literature produced through the most prestigious journals of the area and how this Special Session could try to fill them. In this sense, considering other publication outputs of the 8<sup>th</sup> ICBR and the goal of addressing some of the timelier and pressing matters of academia, and the social and humanitarian sectors, a first analysis points to the need for launching a call for papers open to the ICBR audience and beyond, to ensure that the goals of this Special Issue are met. Furthermore, in similar terms but in this case looking at the titles and foreseen contents, as well as the expectable larger audience to be achieved, it discusses a possible call for papers for the planned Elsevier books, remarking the differences, in terms of subjects and approaches, of the four books.

Keywords: 8<sup>th</sup> ICBR 2018 publication outputs, Special Issues, book chapters, Elsevier books, call for papers.

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*Theme 4*

ENHANCING DISASTER PREPAREDNESS FOR EFFECTIVE  
RESPONSE AND TO “BUILD BACK BETTER” IN RECOVERY,  
REHABILITATION AND RECONSTRUCTION

## TRACK 4A

### Long term reliability of Build Back Better (BBB)

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## Factors contributing to flood resilience among rural community: case study of East Coast Malaysia

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Based on government records spanning for more than 89 years, flood-related incidents remain as the highest contributor to physical and non-physical damages as compared to other type of disasters. The total economic losses caused by flood is estimated at RM636.67 million (or 68%) from the overall RM934.67 million of total economic losses of all disasters combined. In addition, 95% of disaster victims recorded are those who were affected by flood. From the spatial planning context, almost 31% of villages nationwide have been identified by the National Rural Physical Policy (NRPP) 2030 as a disaster-risk village. Majority of the identified disaster-risk villages are located in the East Coast region of Peninsular Malaysia. With a strong realisation that threat from flood could create livelihood devastation for rural community, the NRPP 2030 has established a specific policy named “Effective Disaster Risk Management”. The implementation of this policy shall be guided by two main strategies namely: (1) developing an effective disaster risk management system; and (2) enhancing disaster preparedness level among government agencies and rural communities. The NRPP policies and strategies are formulated with close reference to the Sendai Framework for Disaster Risk Reduction (SFDRR) 2030, hence signalling government’s acknowledgement of the ability of rural community to be first responders in the event of disasters and to have the capacity to carry out any built back better projects after disasters. This paper is intended to assess internal and external factors that contribute to rural community resilience towards flood disaster from the resilience concept and Sustainable Development Goals. Three study cases (i.e. disaster risk villages) located in the East Coast of Malaysia have been identified using a set of selection criteria namely: (1) Lubok Setol village in Kelantan State; (2) Teladas village in Terengganu State; and (3) Gajah Mati village in Pahang State. Interestingly, Teladas and Gajah Mati villages are located adjacent to the Category 1 river (river basin within the state), and Lubok Setol village adjacent to the Category 3 river (river basin shared with other country which is Thailand). All three rivers as identified by Department of Irrigation and Drainage as river which flooded every year during monsoon season. The questionnaire-guided interview sessions were carried out for these three villages between January (right after the major flood occurred in December 2017) and mid-February 2018, while 90 respondents participated in the survey. The study findings include the fact that community resilience to flood in all three cases are cultivated mainly through adoption of local knowledge and with interventions from related government agencies and non-governmental organisations. Moreover, respondents cum disaster victims did indicate their ability to ‘bounce back’ after the disaster (including allocating sufficient income saving for facing monsoon period, creating upper level storage for water-sensitive furniture and electrical appliances, etc.), signalling positive act of resilience. The study indicates that rural community resilience towards flood disaster are contributed both by the internal and external factors. Findings from this study might have value particularly in strengthening recent/current policies and strategies underlined by NRPP 2030 and SFDRR 2030 to better cope with disasters impact and built back better after disaster including adopting measures and local initiatives.

Keywords: resilience community factors; rural community; Malaysia; flood; disaster.

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## Documentation of physical and social consequences of extreme events: the EXTEND Project

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Climate change is expected to affect the frequency and the intensity of heavy precipitation events in Europe affecting at the same time the frequency and intensity of natural hazards. This change in combination with socio-economic changes in mountain areas poses new challenges to decision-makers and stakeholders related to disaster management. However, each event bearing negative consequences for the community is also a source of valuable information regarding the interaction between the physical process and the built and human environment. Capturing and analysing this information is very important for the design of risk reduction strategies. A systematic documentation of events supports compensation and recovery efforts but also reveals vulnerability patterns and resilience deficits which is the basis for “Building Back Better” (BBB) in the recovery and reconstruction phase. In each country, several institutions are responsible for damage assessments following extreme events. These may include local authorities, emergency services (fire brigade, red cross etc.), insurance companies, research institutes etc. The data gathered during these assessments include mainly information on the natural process (intensity, extent, timeline) and some information on damages on buildings and infrastructure. The detail and nature of the data varies according to the responsible agency for the documentation and the aim of the survey. However, although, recent scientific research shows that social aspects (e.g. gender, age, ethnicity) influence the consequences of natural hazards significantly, they are often ignored by post-event documentation. Studies and post-disaster data analysis regarding social aspects (income, gender, age) mainly focus on developing countries where more distinct socio-economic differences are evident within the affected communities. The EXTEND project focuses on the review of existing standardised methods of documentation of events related to extreme precipitation in the Alpine region (Austria, Switzerland, Germany, Italy). Emphasis is given to special applications and technologies (mobile apps) as well as alternative forms of data collection (citizen science) that enable this documentation. Following a thorough literature review, complemented with interviews and a workshop with experts in the field, good practice examples are identified and existing gaps in the event documentation may be outlined. The final objective of the study is the development of a guideline for the improvement of event documentation in Austria which includes both physical and social aspects and may be used to improve post event documentation in European mountain areas. The guideline aims at improving the quality and quantity of damage related data contributing to a better understanding of the interaction between natural processes and communities. An improved post-event documentation will enhance community resilience to natural hazards and ensure the long term reliability of BBB.

Keywords: precipitation; documentation; build back better; socio-economic data; Alpine region.

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## The role of the architect in times of energy crisis and global warming

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The worsening energy crisis, not only in terms of scarcity but also as a main contributor to global climate change, largely responsible for the growing amount of natural phenomena that put the population at risk, makes it necessary to regulate the growth of cities, specifically regarding the way that it affects the environment. In this context, urban infrastructure and buildings must provide an ever lower environmental burden in terms of CO<sub>2</sub> emissions, energy consumption, and water footprint, among other important indicators. In the case of buildings, not only must their structure be able to withstand a strong earthquake and/or tsunami, but they must also grant passive inner comfort, that is, without the need of extra energy consumption; this is when architects work is fundamental, since they are in charge of designing an envelope that serves such purposes. This presentation reviews the case of the new SERVIU building, a division of the Ministry of Housing and Urban Development of Chile, in Concepción, Bio Bio region, which was designed and built according to energy efficiency standards for thermal behaviour and visual comfort; this building is ready to operate after a catastrophe, especially considering that it is part of the State infrastructure, which should not stop working under any circumstances. The objective was to design an enclosure that would provide thermal comfort and adequate natural lighting in such a way that the operation of the building would be highly autonomous, with lower dependence on energy consumption. For this, a methodology was used that consisted of several dynamic simulations of the thermal behaviour of the building using specialised software TAS, so that in each model the composition of the façades was changed until reaching the desired thermal performance. In relation to the methodological aspects, the development of the energy efficiency project addresses the quantitative and qualitative aspects of design in the architecture of the building; quantitative, since the project seeks to reach very low levels of energy consumption in heating, cooling, and artificial lighting, and qualitative because the changes made to the envelope in each modelling should reflect the design and semantics proposed in the architecture. Regarding the results, it was possible to reach high performance levels in heating and cooling, equal or less than 37 kWh/m<sup>2</sup>/yr for heating demands and less than 10 kWh/m<sup>2</sup>/yr for cooling, with good autonomy in natural lighting. As a conclusion, the paper highlights the importance of generating a resilient architecture, capable of operating in a post-disaster scenario and able to reduce the impact on the environment throughout its life cycle, especially in a building whose main function is to provide social housing to the population, and particularly in reconstruction processes.

Keywords: climate change; sustainable design; energy efficiency; resilience; public initiative.

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## An innovative approach to post-disaster reconstruction and future resilience through amphibious foundation systems

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Amphibious housing presents exciting possibilities in the quest for sustainable and resilient responses to the impending global climate change crisis. Suitable new housing types are needed for populated regions where sea level rise and heightened storm activity are expected to intensify flooding. Amphibious or buoyant foundation systems refer to new or retrofit construction that allows a house to remain close to the ground with the appearance of an ordinary house, but to rise with rising floodwater and float on the surface until the flood recedes, at which time it settles back into exactly its original position. This is a highly innovative approach to disaster preparedness, flood mitigation and climate change adaptation that is in initial stages of technical development and refinement. In environmentally sensitive locations, amphibious construction suggests how to sit lightly on the land and live with the flooding, temporarily, when it occurs. Amphibious strategies accept the presence of floodwater but prevent it from causing significant damage. Amphibious architecture works in synchrony with natural cycles of flooding, allowing water to flow where it will rather than attempting to control it. Since the height to which an amphibious building rises will vary with the depth of the water, amphibious structures can take both changing sea levels and land subsidence in stride, and reduce the challenges of recovery and the necessity of repair or reconstruction. This presentation will report on preliminary results from two funded studies that focus on constructing prototype amphibious foundations for existing flood-prone houses on Canadian First Nations reserves and in Vietnam's Mekong Delta. The First Nations community of Lake St. Martin is vulnerable to the seasonal flooding of the Interlakes Reserve in central Manitoba. Community members have been evacuated and relocated repeatedly during flood events, disrupting their lives and destroying community cohesion. Amphibious housing would support the community's preparedness and resilience, adhering to the "Build Back Better" framework. Recently completed amphibious retrofits to houses in the Mekong Delta will increase community resilience and improve the financial stability of residents living in poverty by reducing property damage and the need for relocation during severe floods. Project outcomes will inform design standards, in line with "Build Back Better," to support continued implementation throughout the region. An amphibious foundation approach encourages recognition of the beneficial aspects of the occasional presence of water: we need not merely learn to live with water, we can thrive with water. While amphibious strategies are not universally applicable, they have great potential to benefit vulnerable indigenous populations that currently face the difficult choice between leaving their traditional homelands or living with the disruption and devastation that severe unmitigated flooding and subsequent lengthy evacuations can have on their communities. Successful implementation of the amphibious prototypes will most importantly reveal needed changes in building codes and policies to integrate the amphibious approach into preparedness best practices. A fully tested set of design guidelines will ensure that amphibious foundations can play a role in preventing future disasters by enhancing the safety and resilience of housing, settlements and communities.

Keywords: Build Back Better; community resilience; non-structural flood mitigation; disaster preparedness; climate change adaptation.

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## Assessing the role of post-disaster resettlement in building resilience: case of the 2010 Floods in Pakistan

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Post-disaster resettlement offers an opportunity to “build back better” by developing resilient and sustainable communities. Flood disasters are a perpetual phenomenon around the world causing widespread economic losses and displacing millions of people. Frequency and intensity of flood events have increased in the past two decades, particularly due to climate change which specifically impacted the communities in developing countries. Extreme flood event of 2010 in Pakistan created an extensive internal displacement of rural communities, resulting in large-scale governmental and non-governmental initiatives to resettle the displaced population in Model Villages away from the vulnerable flood basins. These Model Villages were aimed to be resilient and self-sustaining rural settlements with various amenities like schools, health centres, solar-powered houses, paved roads, sanitation facilities, livelihood opportunities etc. The Model Village concept is quite new in the context of post-disaster resettlement and their role in building community resilience and well-being has not been explored in Pakistan. Moreover, relocation planning and development strategy differs significantly for governmental and non-governmental organizations and requires investigation. Considering this gap, this study attempts to assess the role of Model Villages in building the resilience of relocated communities using both quantitative (index approach) and qualitative approach. In addition, this research has examined the differences in public and private sector developed Model Villages and their impacts on the resettled communities’ resilience. Therefore, four Model Villages – two developed by government and two by Non-Governmental Organizations – were selected as a case study in the severely flood-affected province of Punjab, Pakistan. An overall sample of 145 households from four Model Villages was collected using structured questionnaire to measure improvements in social, economic, physical and environmental domains and to develop a final resilience index. Other tools like expert interviews and personal observations were used to achieve the objective of the study. Analysis suggested that private sectors are more successful in improving the overall situation of relocated households than the public sector. High level of public participation in overall planning and development of Model Villages, provision of livelihood opportunities, livelihood skill development based on local market demand, training on maintenance and operation of difference facilities in Model Village and provision of extensive education opportunities especially for females are core factors in increasing the resilience of communities resettled by private sector. The results of this study can guide the policy makers and development planners to overcoming existing deficiencies by integrating private sector in shaping resettlement policies as well as in future planning and development of resettlement schemes to make the whole process successful.

Keywords: relocation; disaster risk reduction; resilience; sustainable; Pakistan.

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# Challenges of post-disaster reconstruction projects: an empirical investigation according to project management knowledge areas

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Disaster recovery phase is considered as a critical aspect that includes both the rehabilitation and reconstruction projects, where the latter is the primary focus of interest in this paper, and it is usually more complex by their very nature. There is a growing interest toward a better understanding of the management of PDRPs, as part of a global concern for increasing resilience at all levels. Successful project management approaches disaster management operations that can ensure the efficient usage of scarce resources and leads to improved outcomes. However, the literature on PDRP management is yet in its embryonic stage and systematic research efforts are needed to address the topic, since the available resources on the management of different aspects of PDRPs are scattered over different resources. Recent literature on PDRPs suggests that the disconnection between the general project management literature and its application to the PDRP context is related to the unique features of such projects, which require emergent strategies; ability to cope with the complexities arising from uncertainty, time pressure, community vulnerability and stakeholder relationships, which pose different challenges relative to typical projects. This paper aims to compare the challenges faced in the conventional projects and PDRPs according to project management knowledge areas. Project management knowledge areas provide an extensive guide on the management of the different aspects of projects, which are expected to be integrated by project managers within the realm of each project. According to many professionals, the objective of any project is to achieve the desired quality, as described by its stakeholders, considering its primary constraints including budget, cost and scope - 'The Project Management Triangle.' This 'triple constraint' perspective is criticized due to its ignorance of the project managers' limited control over the external factors, which may easily change the balance between scope, cost, time and quality, or due to project managers' incapability to balance all the objectives and requirements of stakeholders in a project. Such criticisms call for an analytical evaluation of the interdependencies between different areas of expertise within PM, considering the peculiarities of different types of projects such as PDRPs. Due to the unique features of a project and the composition and magnitude of controllable and uncontrollable factors, the focal point of 'the triangle' may be settled in different ways and the level of expertise needed regarding different knowledge areas and the associated tools and the techniques necessary may also change. A descriptive-exploratory research was designed and qualitative data from literature and interviews with managers with PDRP experience from different countries were analyzed. The findings clarify the interdependencies between project management knowledge areas within the context of PDRPs. Managing stakeholders, risks and communications appear critical to cope with an evolving scope, while procurement management has a significant impact on project outcomes due to the scarcity of resources. A structured comparison of the differences between conventional projects and the PDRPs can be a valuable input for amplifying reference sources for managers, who may undertake such projects in future.

Keywords: project management; post-disaster reconstruction; project management knowledge areas; project management triangle.

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## How reliable is Build Back Better at enhancing socio-ecological resilience?

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The slogan – Build Back Better – has caught global attention, evident in the approach being identified as one of the dimensions in Disaster Risk Reduction (DRR), as per the Sendai Framework for DRR (2015-2030), despite its several severe limitations. The paper critically examines the long term reliability of BBB approach from a socio-ecological systems (SES) resilience framework. The concept of disaster resilience itself has been understood in varying manner (e.g. engineering resilience = resistance or controlling change; social or ecological resilience = recovery/ adaptation to an improved state and SES resilience = continuous system transformation or self-re-organization). The authors argue that while BBB strategy may seem systemic, it fits squarely into engineering, social or ecological resilience focused on system resistance or at the best, system adaptation (i.e. an improvement from pre-disaster condition in housing, settlements and communities). Moreover, disaster resilience is considered to be an ongoing or continuous activity. The characteristics of SES resilience – transformation and ongoing – have largely remained untouched within the DRR community. A system can be as broad or as narrow as one defines it to be. For the purpose of this paper, system is defined at the scale of settlement and includes human and built environment's interactions with the natural environment. This paper reports on longitudinal (>7 years) examination of housing reconstruction projects using mixed methods methodology (architectural and human geography) to identify reconstruction processes and practices that have been successful at bringing systemic changes or enhancing resilience from SES perspective. Two reconstruction projects are selected for comparative case study investigation: 1) an owner-driven reconstruction project following the 2008 Kosi River floods in Bihar, India and 2) donor or government driven reconstruction project following the 2010 Mentawai Earthquake and tsunami in Indonesia. The underlying risk factors, policy, government/governance setup, reconstruction approaches (enabling or providing), on-the-ground practices, capacity building efforts and their long-term impacts were analyzed and compared between case studies. Social sciences method of semi-structured interviews and architectural method of visual documentation were used. 18-20 respondents were selected from each case study based on purposive sampling. The two-country comparison provides richer perspectives and ability to draw-out similar patterns to lead to generalizable findings. The findings suggest that concepts such as – capabilities and capacity building – that have emerged from fields of studies outside built environment, such as – development studies and engineering, social and ecological studies, respectively; have a major role to play in the long-term reliability of BBB. While some of the findings are in line with already accepted – need for an owner-driven, process-driven, multi-stakeholder and multi-disciplinary approach – other findings underscore three things: i) the importance of systems-based strategic visioning (e.g. social profiling, vulnerability patterns and resilience deficits), ii) capabilities-based approach (freedom of choice to the people in developing countries, same as in developed countries) and iii) sustained capacity building efforts (long after the completion of projects). These findings further develop the current scholarship on long term reliability of BBB (through reconstruction) in terms of carving multiple pathways for transformational adaptation or enhancing resilience and thus, DRR.

**Keywords:** Build Back Better; socio-ecological system resilience; disaster risk reduction; housing reconstruction; post-disaster recovery.

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## Measuring the impact of technical shelter interventions on the resilience of vernacular housing to typhoons in the Philippines

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The Philippines is one of the most typhoon exposed countries in the world, receiving on average 20 typhoons a year. These events can cause significant damage to land and buildings, leaving many householders needing to repair and reconstruct following a typhoon. In this context Build Back Safer (BBS) messaging has been developed and deployed in the Philippines by the international NGO shelter community as an assistance mechanism. The messages focus on minor technical modifications that can be made to shelters, such as through roof shape and joint design, with the aim of aiding those reconstructing to produce more robust structures. Despite considerable efforts by the shelter community to promote these messages, studies have shown that their uptake can be limited, and that communities and homeowners typically continue to use traditional and pre-existing building practices, especially when the recovery process is driven by the householder. Factors outside of physical robustness are also now being recognised as equally significant in the consideration of how to rebuild, such as availability of resources and funds, wider climate comfort aspirations and land tenure uncertainty. The study undertaken here presents an assessment of the impact of implementing technical interventions on the structural robustness of traditional timber Philippine housing to typhoon wind loading, in the wider context of traditional design features and resource availability. A series of case study shelters in rural and urban communities in Leyte are used as reference structures, to profile the physical and human factors involved in determining reconstructed shelter design. A series of typologies derived from the case studies are assessed using models for wind-structure interaction, with a focus on building form, façade materials and frame design. Initial results from the assessment suggest that BBS messages can lead to direct and significant increase in structural performance, for example through the incorporation of bracing. The assessment also shows that traditional architectural features, such as porous cladding, can also reduce wind loading effects, offering complimentary means of increasing resistance to wind induced damage. This study highlights that measuring the contribution of traditional design features to reducing wind induced damage offers more detailed and meaningful guidance on the overall robustness of reconstructed timber structures in the Philippines. This approach is intended to provide those designing technical interventions with a broader scope of information on which to base future BBS messaging strategies. Discussion of the findings of this work explores the role that technical interventions should play in defining Build Back Better aspirations. This includes consideration of other building performance features, for example protection from excessive heat, and the feasibility for householders to invest in enhanced structural design when they have wider economic and site security concerns. The role of these considerations in promoting prolonged uptake and ownership of technical modifications by affected householders is discussed. The objective is to assist the humanitarian sector in advising communities following a typhoon, by presenting an approach to reconstruction that aspires to achieve long term, resilient solutions for those affected.

Keywords: Philippines; typhoon; vernacular; shelter; resilience.

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## **The nature of road reconstruction intervention in post-conflict Sri Lanka: linkages to peace and reconciliation**

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The physical reconstruction of infrastructure is widely accepted as an essential component of building back better to support recovery and rehabilitation after a disaster. In a post conflict setting, reconstruction is additionally related to conflict resolution and reconciliation. Therefore, it is important that the reconstruction accounts not only for economic costs and benefits, but also politically and socially sensitive issues such as trust, equality, regional differences, ethnic identity and inter-ethnic interactions. In Sri Lanka, the various policies, capacities, structures and power politics of government institutions has significantly influenced the reconstruction process in different parts of the country. In this paper the nature of reconstruction intervention in post conflict Sri Lanka is analysed, primarily focusing on the role of national and local governments. As a part of a major study on consequences of post conflict reconstruction, the paper discusses the various elements associated with governance such as ethnic representation, seniority, political power, corruption and elections, in relation to road infrastructure reconstruction in post conflict Sri Lanka. It also derives significant linkages between the nature of reconstruction intervention and the long term impact such intervention can have on reconciliation and peace.

**Keywords:** post conflict; reconstruction; road infrastructure, intervention, Sri Lanka.

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## Development of multicriteria analysis to support the decision to rehabilitate a qualified public building

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The building rehabilitation emerges as an opportunity for the construction sector to readapt, betting on the requalification of the existing building heritage, improving, if possible, its quality based on sustainability principles. In this sense, when interventions financed through public funds are planned in a qualified public building, there are several opinions that can support the decision to intervene or not. The recognition of a qualified public building implies an increased responsibility in the actions of conservation and rehabilitation of the same. The possible interventions in a qualified public building must be rigorously evaluated in a way that guarantees the preservation of the elements that confer the patrimonial interest to the building. This kind of projects should be rigorously studied to get the most information possible on the current state of the target element of intervention. To minimize the complexity of a decision-making process it is sometimes necessary to apply methodologies and / or support tools such as the models based on Multicriteria Analysis which allows for public decision support in complex problems that usually involve multiple viewpoints and opinions. In this way, it is possible to establish a common language of argumentation and discussion of the perspectives and points of view defended by the different intervening actors, facilitating the generation of new decision opportunities and choice alternatives tending to overcome any divergent points of view. This process will help the decision-maker in definition of the priority interventions to be taken while minimizing their impact reducing expenditure and maximizing the of public funds investment. The work developed includes: i) the complete description of a Portuguese public building object of the study; ii) the survey of the observed anomalies; iii) the detailed presentation of the techniques used in the proposed intervention solutions. The analysis developed considers the technical description of the specific interventions as well as the costs implicit in them. The results obtained will allow demonstrating that the use of certain techniques in qualified public buildings should be considered at the design stage to ensure that the integrity of the property remains intact during its entire life cycle. In addition will be presented the main conclusions of the study developed and the prospective of future developments, namely concerning the generalization of application of multi-criteria analyzes to support the decision making to intervene in the rehabilitation of different types of qualified public buildings.

Keywords: multi-criteria analysis, decision support, buildings rehabilitation.

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## The underlying mechanism of resettlement dissatisfaction

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Post-disaster resettlements, particularly ones with a donor-driven approach, are often criticised for their inability to create long-term adaptability for both the built environment and for the people. Studies show that the well-established disaster-recovery process, which includes response and relief, recovery and reconstruction, mitigation, and preparedness, is not often sustained until the end of the process. This is a potential obstacle to ensuring that the resettlements last for a long time. Thus, understanding of the resettlement dissatisfaction is essential to determining solutions. Accordingly, this paper aims to develop a model to explain the underlying mechanism of resettlement dissatisfaction. Based on the philosophical stance of the researcher, namely critical realism, this study presumes an underlying reality that shapes the observable events. Accordingly, the retroductive approach was followed to discover the underlying mechanism of resettlement dissatisfaction by working back from the observed regularities to a possible explanation. A multiple case study was conducted in Sri Lanka to observe regularities. Attempt is made in this paper to construct a possible explanation for resettlement dissatisfaction which could be explained based on the common features identified across cases. The underlying mechanism model is presented as a graph relating the phases of the resettlement and the desire of the victims to possess a house. According to the identified underlying mechanism, the desire to possess a house remains at its peak through the displacement period. The reasons for this initial attraction of the house are: want of safer alternatives, traumatic impressions of previous location associated with the disaster, and fascination with the new house. Subsequently, during normalisation, the desire to remain in the resettlement declines for five reasons identified in the present study. They are namely, availability of alternatives, gaps and barriers of implementation process, the fading of traumatic impression and newness bias, unfavourable conditions in the new location, and tendency to make economic gain out of houses by selling or letting. This shows that at this phase the settlers recognise their actual needs from resettlement, and the prevailing reasons for the desire to remain during the first two phases fade off. The decline in desire to remain, leads to dissatisfaction if resettlement is managed inadequately. Favourable conditions or the attracting factors in the resettlement location can arrest the decline to some degree. However, addressing the causes of decline is essential to sustain and achieve the primary purpose of the resettlements.

Keywords: resettlement, underlying mechanism, dissatisfaction, long-term, Sri Lanka.

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## TRACK 4B

### Resilience and Right to the City in European urban margins: the role of civil society in housing processes

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## Right to the City? Socio-spatial inclusion of economic migrants and refugees in Southern Europe: two case studies from Lisbon and Turin

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The paper addresses socio-spatial inequalities concerning economic migrants and refugees in metropolitan areas in the South of Europe and puts in perspective local initiatives with a renewed vision of the Right to the City, as elaborated by Lefebvre, paying attention to the materialisation of the Right to adequate Housing for all. We aim at investigating the role of local authorities and organised civil society in regenerating inclusive socio-spatial transformation linked to cultural diversity. We focus on two case studies considered exemplary by local authorities and presenting significant agency by civil-society actors. In Portugal, the case study concerns Marvila, a neighbourhood located within the Lisbon municipality. “Refugi.Arte em Marvila” is a planned art-based inclusive shelter for refugees, economic migrants and low-income residents. A local architectural cooperative ‘Working with the 99%’ has been spearheading the process. The objective is to contribute to the inclusionary revitalisation of Marvila Street and surrounding areas through the rehabilitation of a municipal underused heritage facility: Marquês de Abrantes Palace. In Italy, the case study is located in Valli di Lanzo in the Turin’s metropolitan area. Here the Morus Association supports a small number of migrants with refugee status helping them to find housing and employment in the region. To do this, volunteer workers map individual needs and competencies so as to match these with appropriate opportunities; this process helps to identify art, sport, and professional activities, and to build relationships among new arrivals and longstanding residents. Both the cooperative and the Morus Association have supported a range of cross-cultural projects. In Lisbon, the presence of the cooperative in Marvila Street points to the importance of long-term involvement for successful inclusionary interventions. Moreover, the involvement of a multidisciplinary team has broadened the perceptions of the area, helping to bring out its potentials. Also, the focus on community participation has led to a gradual appropriation of the project by local residents. In Turin, emergent collaborations between Morus Association and local authorities focusing on hosting and refugees support are still being developed. At present, many local authorities fear that proactively supporting refugees and asylum seekers may trigger opposition by sectors of the local population. Compared to local authorities, civil-society actors have been offering more flexibility and capacity of action for the inclusion of economic migrants and refugees. While the resilience dimension of housing policies is being weakened by the lack of municipal initiative, grassroots activities centred on cross-cultural encounters seem to have a potential for generating socioeconomic initiatives based on active citizenship. The paper discusses these initiatives in terms of their potential concerning: (a) the ability to stand on their own feet; (b) the opportunities for involving local institutions in generative debate and actions; (c) the risk of being co-opted by local authorities; and (d) to what extent they constitute an original move towards materialising the Right to City and the respect of the right to housing for all.

**Keywords:** Right to the City; right to housing; economic migrants and refugees; inclusive socio-spatial transformation; Southern Europe.

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## Refugee integration in Portugal: the new challenges of the European Relocation Program (2015-2017)

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Since 2015, Europe has witnessed the largest mass displacement since World War II. During this period, more than one million people would apply for asylum in the European Union (EU), the great majority escaping from the war and trying to reach Europe, via the Mediterranean, generally with origin in Syria, Eritrea and Iraq. The islands and coast of Greece and Italy are some of the places where the vast majority of refugees and migrants entering the EU have arrived. Many of these people are seeking to reach other EU countries – such as Germany, Austria, Hungary or Sweden – to which are directed almost three quarters of European asylum applications. The “European Agenda for Migration”, presented by the European Commission on May 2015, would reflect this concern. And, at the level of immediate response, it would propose the implementation of an emergency relocation mechanism, within the EU during the two following years, in order to transfer 160,000 people from Greece and Italy, under extreme migration pressure, to other EU Member States. In response to these decisions, the Portuguese Government announced in 2015 the availability to receive 4,574 refugees, over the two following years, and created a “Working Group on the European Agenda for Migrations”, coordinated by the High Commission for Migrations, with the goal of gathering efforts from Portuguese institutions and citizens, who show willingness and conditions to support the reception and integration of these refugees. According to the International Organization for Migration (IOM), the EU Relocation Program’s situation is currently of 33,811 people placed in 24 countries – 21,824 from Greece and 11,987 from Italy – and Portugal is currently positioned at the 6<sup>th</sup> position in the European ranking of refugee relocation processes – with 1,532 relocated persons, 1,192 from Greece and 340 from Italy. Showing that despite being a small country, Portugal has tried to make an effort on this particular matter, with very tangible results, such as the 50% employment and professional training success rate of the asylum seeker received in the country, the 100% and 81% integration rate in its national health and education systems or the establishment of a focused scholarship program to access Portuguese public university system. So, after the ending of the two-year European Relocation Program, which finished on 26<sup>th</sup> September 2017 – and in the context of the 8<sup>th</sup> ICBR, *International Conference on Building Resilience*, under the theme “Risk and Resilience in Practice: Vulnerabilities, Displaced People, Local Communities and Heritages” –, the aim of this paper is to analyze the Portuguese Relocation Program, that lasted from December 2015 to November 2017, trying to produce not just a mere description of the implementation of this particular program, but a portrait of a different approach on a national asylum policy, that was based on a dialogue between national institutions, local stakeholders and people of different origins and cultures, seeking to ensure a structured response capable of promoting the integration of relocated refugees in the Portuguese society.

Keywords: refugees; integration policies; European Union; Portugal.

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## Future scenarios for cities: are calculated models enough?

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Urban risk reduction for resilience does not happen in a vacuum but needs to be aligned with urban development, considering also economic and environmental aspects. With increasing risk levels and triggered by policy documents of the Post-2015-Agenda, urban resilience moved to the centre of attention and was adopted as a development paradigm in many cities, striving to increase the cities' capacities for preparing for, responding to, learning from and adapting to adverse events and changing environmental conditions. To implement adopted aims, the availability and use of suitable methods for integrated urban development are essential prerequisites. Such methods should provide help for identifying ideally both, potentials to mitigate climatic impacts as well as possibilities to prepare for future climatic and social risks. While in the past, urban governments and planners predominately addressed physical aspects of the built environment to increase the robustness of cities against natural hazards, it is now widely acknowledged that only a mixture of so called hard and soft (social) measures will successfully contribute to cities' overall resilience. However, this paradigm shift is not yet well reflected in the methods used to drive urban development processes which are mostly based on quantitative models, projecting past trends into the future under certain assumptions regarding climatic and demographic trends. The resulting scenarios do however neither consider strategic visions determined by city governments and social transformation nor do they incorporate the potential impact of changes on larger scales beyond the administrative borders. This contribution will present the method of participatory scenario development, which aims at incorporating future socio-economic and political development trends into the compilation of alternative urban futures. The method largely builds on the participation of urban administrative stakeholders from different sectors and results in four different potential future scenarios including storylines, which provide a valuable frame for both, physical and socio-economic urban models as well as for political decision-making. As an example, the presentation will showcase participatory scenario developments conducted in the course of a research project financed by the German Ministry for Research and Education. Scenarios were developed together with the urban administration of Bonn and Ludwigsburg, two cities striving for increasing their resilience towards heat stress. It will show how this new method can help policy-makers to better understand interlinkages between policies and spatial urban development processes, including benefits and pitfalls of planned policies and trends on different actors and sectors such as housing. Furthermore, it will provide evidence how participatory scenarios can build a frame for climatic and socio-economic modelling. While the intersection of various scenario methods represents a challenge, it has large potential to culminate in more realistic and holistic scenarios for urban futures. Going beyond the classic models it can inform decision-making for urban authorities to make their cities more resilient. On a more conceptual level it will be discussed how far such method – if adopted by urban administrations – can give more room of manoeuvre to all players involved in fast-changeable urban areas in the light of debates on the right to the city.

Keywords: participative scenarios; storylines; urban resilience; urban decision-making; novel instrument.

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## Housing and tourism in the increasingly urbanised Azores: challenges and opportunities for the right to the city in São Miguel Island

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Current global urbanisation trends are manifested in the Azorean archipelago in the growing number of building permits and building constructions and reconstructions, especially those related to housing (Statistic Regional Service of the Azores – <http://srea.azores.gov.pt>). This phenomenon is particularly evident in the larger and most central island of São Miguel (Rocha & Ferreira, 2010). However, the Azores is also one of the Portuguese regions with higher risk of poverty (Diogo, 2015). In São Miguel confined insular context, the urban margins where lower income groups live correspond to areas relatively integrated in (or close by) main urban centres. Currently, this urbanisation process has also been fostered by the recent growth of tourism, equally more significant in São Miguel, boosted by its promotion since the mid-1990s and the opening of airspace to low-cost airlines in 2015. Tourism tends to be linked to the commodification of socio-spatial assets, and thus to processes of gentrification, ‘museumification’ and ‘disneyfication’, which usually contribute to increasing socio-spatial disparities and fragmentation (e.g. Delgado, 2005; Gant, 2012; Pavel, 2015). In this context, in São Miguel, most important urban centres have been under major transformations – e.g. growth of housing rental for tourism, changes of use, renovation of older or abandoned buildings, construction of new ones – some of them partly promoted by public policies, such as the funds for urban upgrading and renewal and the programme “renew for rent – affordable housing”. Some of these usually market-driven urban transformations have had impacts on areas where lower income groups live, normally through gentrification, promoting the emergence of resistance movements claiming for a greater ‘right to the city’, developed by groups of the organised civil society, such as those gathered by the project Caravan for the Right to Housing. Based on a research project about the impacts of tourism on the Azorean landscape (Melo, 2017), this presentation aims to reflect particularly on those felt on the housing of urban margins, taking into account the urban transformation trends at place in main urban centres of São Miguel, as well as on resistance movements that arise from them and on challenges and opportunities that emerge to a greater right to the city.

Keywords: urbanisation; tourism; housing of urban margins; right to the city; Azores.

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## Belgrade: reconstructing Balkanism, reconstructing rights

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The context for this exploration will be Belgrade in the aftermath of NATO's 1999 NATO targeting. The focus will be on how the reconstruction of the city, including the transitional post-socialist identification, is contingent with undulating systems of control. An aspect of control is further found in EU's contractual relations in that the Europeanization of all Western Balkan countries requires their full political separation (balkanization) from each other - homogenization, and subsequent recognition of each other. A way of achieving this has been through a process of association; Belgrade, as well as Western Balkans, are seen as a transitional zone in need of attaining democratic values and socio-political co-operation. One element of cooperation is seen by the reconstruction of Belgrade being mainly driven by international investment, foreign loans, contractual stipulations by the European Union and corrupt Serbian politicians. One of the outcomes of reconstruction is gutting out all sense of socio-economic diversity and alternative design and cultural practices. Since 1999, New Belgrade's unfinished and unfilled CIAM blocks are now being filled with shopping centres and private multi-use buildings, appropriated to suit the narrow interest of neo-liberal entrepreneurs – consumption and privatization made possible by de-nationalization laws whose governing notion is that public companies and individual buildings should be privatized. The socialist right to a residence is now being replaced with a new understanding: the residence as a commodity. The once relatively hegemonic brutalist block-type building typology has been diversified, though now driven by a global neo-liberal economics. Diversification has translated into a demarcation between neighbourhoods, where there is a discrepancy in aesthetic language and socio-economic levels. While there is a greater level of heterogeneity in the current typology of Belgrade's buildings and products, the fact that these are predominantly causing economic polarisation makes the hegemony fiercer than its socialist predecessor. This is evident in the ordering of values and ways of living, lack of transparency to do with urban development, privatization, de-socialization and de-Romanization (forceful relocation of the Romani to the fringes of the city). In this post-1999 political landscape, Henri Lefebvre's thinking on the 'right to the city' is being eradicated; Belgrade is more exemplary of Michel Foucault's disciplinary and Gilles Deleuze's control societies. The stated framework will specifically be mapped in terms of two central areas of Belgrade – Savamala and Belville. This is not only because the two zones exemplify severe gentrification, but also because gentrification is removing the alternative practices and ways of thinking about the city found within Savamala and Belville. These alternatives, such as the Mikser House/Festival and the Romani settlements, evoke Maria Todorova's association of Balkanism where 'inhabitants do not care to conform to the standards of behaviour devised as normative.'

Keywords: Balkanism; Belgrade; control; reconstruction; rights.

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## Transformative practices? Resisting evictions in Lisbon Metropolitan Area

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The presentation will draw from an ongoing PhD research on forced evictions in the Lisbon Metropolitan Area (LMA). Forced evictions have recurrently been approached as a phenomenon of the Global South, related to rural land grabbing or urban slum clearance, ejecting people from their homes in the name of “progress”. However, there is increasing evidence of violent displacement in the Global North, related to new forms of social inequality and heightened housing insecurity (Brickell et al. 2016: 1-2). The city of Lisbon and its metropolitan area provides a fascinating case to investigate these dynamics. Lisbon is a European capital, and thus a city of the Global North, but at the same time it has often been conceptualized as a semi periphery, as an intermediating space between the North and the South, or, an example of the “South of the North” (Nunes and Serra 2003: 216). In terms of eviction, in Portugal, there is a long history of demolition of shanties, in a process during which only a part of population has been offered alternative housing, resulting in some parts of population being simply displaced. These expulsions continue until today in some Portuguese municipalities, such as Amadora and Vidigueira. This is an interesting backdrop to the more recent phenomenon of financialization of housing and the evictions from private rental apartments. In the last years, LMA has seen a strong wave of civil society movements fighting for the right to adequate housing and to the city. It can be argued that their action has resulted in increased political and media interest, making housing a central theme in the 2017 local elections. This year, in the run-up for the 2019 legislative elections, many civil society housing rights movements aim for increasing the pressure to change some key laws related to housing, such as New Regime on Urban Lease Scheme of 2012, and push for the effective implementation of inclusive policies such as “1º Direito” (First Right) and “Programa do Arrendamento Acessível” (Affordable Rental Program). The study will examine the processes that legitimize the right to housing and to stay put for some people and disassociate others from it, by analyzing how these processes are being negotiated, reworked, supported or contested by diverse groups of actors. It will reflect on the strategies mobilized by different actors, such as the officials of Portuguese state institutions, real estate and land owners, community organizations and residents to address evictions and right to adequate housing. The project will ask whether the practices of resistance are transformative to the existing conditions of social life and to the power relations between the elites and residents of marginalized neighbourhoods. The presentation bases itself in the qualitative data acquired by ethnographic methods: participation observation as well as informal and semi-structured interviews during the year 2018.

Keywords: forced evictions, resistance, social movements, right to the city, Portugal.

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## Democra-city: participatory approach and requalification of the marginal self-produced city

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Contemporary cities are called to face problems and take up challenges that cannot find a solution in current global paradigms of intervention. Rising socio-spatial inequality and urban exclusion urge communities to participate in decision making processes heading to the transformation of their neighbourhood. A participatory approach is more and more often evoked while generating practices of emancipatory nature almost worldwide. However, participation has been also increasingly appropriated by the neoliberal discourse and sometimes becomes a mere expedient for the co-optation of consensus. This paper aims at critically reflecting about limits and virtues of participatory approach and about its socio-spatial impact on marginal self-produced city. The notion of 'self-production' has been already used by researchers of the GESTUAL (*Grupo de Estudos Socio-Territoriais, Urbanos e de Ação Local*) of the Faculty of Architecture of the University of Lisbon. It refers to Lefebvre's production of space notion – not only to self-construction – and it aims at drawing attention to the energy spent by the 'producers' of spaces. Through a comparative analysis of empirical cases, I intend to understand to which extent diverse types of participatory interventions and interactions between the actors interfere in the production and transformation of space and can contribute to community emancipation, but also in which circumstances an alternative city model emerges and which forms it may take. Different interventions will be evaluated at the level of: (1) strengthening democracy among the actors involved and community empowerment; (2) social and urban inclusion, as well as spatial justice; (3) urban and housing quality, and (4) environmental and socio-economic sustainability; to identify which processes can lead to a more democratic, empowered, inclusive, just, more qualified and sustainable marginal city. Such cities I define here as 'democra-cities'. Two neighbourhoods of the Metropolitan Area of Lisbon will be considered: Cova da Moura (Amadora) and Bairro da Torre (Camarate) for representing different participatory essays, namely small participatory local interventions. The critical interpretation of the two processes and the assessment of these experiences against current trends at a global level will be carried out at the light of Henri Lefebvre's *Droit à la ville*, in its emancipatory meaning of *Droit à l'œuvre* (Right to the work) which is everybody's right to active participation, co-authorship and co-transformation of the neighbourhood and the city. In this sense the paper discusses the notion of a more imaginative and experimental participatory approach, a kind of 'deambulatory' attitude of listening to people and places that, when implemented in a different and case-specific way, can effectively contribute to increase urban and housing quality as well as create social inclusion and emancipation, in line with Lefebvre's *œuvre*.

Keywords: participatory approach; marginal self-produced city; paradigms of intervention; Right to the city.

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## Assembling an alternative: pushing the development of a new housing programme in Porto

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The aftermath of the recent economic crisis has aggravated existing housing problems, namely in the main Portuguese cities, where the sudden capital concentration – encouraged by new public policies and tourism trends – has profoundly changed the housing market. To the already existing precarious housing conditions (as shown by Leilani Farha's report) one must now add the fact that not only the poor but also a substantial part of the middle classes are struggling to find affordable houses in these territories. This context led to the rise of a broad public debate that is taking place in different forums and earning increasing attention of the media. It also led to the proposal of a New Generation of Housing Policies by the Government, which has the merit of, not only acknowledging the problem, but also framing it by a set of new intervention tools able to establish goals and to identify actors and their responsibilities. Based on a specific case, we will present the opposition those new discourses and policies are facing, as well as the opportunities they create for the development of alternative practices. We will also discuss the role academic and third sector organizations may have in this process. In Porto, Habitar (a third sector association) joined MDT-CEAU-FAUP (an academic research group) to trigger the creation of a new local housing programme they are developing in partnership with the municipality and IHRU (the national agency for housing and urban renewal). The programme targets run-down buildings' owners who do not have the means or the will to enter the established housing market. It will grant them incentives as well as financial and technical support for the renewal of their property, through a simple, fast and transparent process centralised in one sole front office. The renewed housing units will then be accessible at affordable rents. It is a sustainable low cost programme, based on the activation, connection and mediation of already available resources and actors. This process will show how technical work is essential to move from individual practices to general policies. It will also show that this technical work is not created in a vacuum, but inside a network of social representations and relationships that can be changed. As a conclusion, we will argue five points: 1. Implementing a transformative technical solution depends on the creation of a previously non-existent political space. 2. This political space must find shelter in the existent established institutions. However, it must be construed by elements based on a cultural matrix common to all actors involved in the conflict. 3. Those elements have a social expression. However, they are not necessarily the ones to be found in the discourses and practices of different actors. 4. The aim is to express the conflict in ways that contain the arguments of activists and experts' groups; but, at the same time, those ways must be able to occupy a broader social space. 5. A technical solution will never be transformative if it cannot function both inside and outside established institutions.

Keywords: institutional innovation; affordable housing programme; bottom-up processes; emerging practices; local policies.

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## Development of humanitarian logistics network design: a genetic algorithm approach

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Disaster as defined by United Nations is a serious disruption of the functioning of the community or society due to hazardous event. Disasters have been frequently occurring in all countries in random order. It is therefore, important to help the disaster's victims to provide for their immediate needs in a timely manner. This will also lead to helping them build resilience in time of this hazardous event. The study aims to design a humanitarian logistics network to reach the beneficiaries in shortest time possible and in cost effective manner. The study approaches are field site visits, interviews from the authority concerns and the use Genetic Algorithm Approach. The results showed that the proposed model is better than the existing Humanitarian Logistic Network Model of the case study Organization being investigated. The considerations of the multiple objectives such as responsiveness, risk and cost effective manner in the design makes the humanitarian logistics model feasible and applicable in the organizations. The study concludes that providing a decision support system to the emergency managers and decision-makers there will be an effective and efficient humanitarian logistics in the country.

Keywords: disaster, humanitarian logistics network, genetic algorithm.

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## Quality of inhabiting in the urban margins of the Lisbon Metropolitan Area: the role of academia

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Portugal is currently discussing a new generation of housing policies and a Basic Law for Housing aiming to combat the persistence of structural housing problems in suburbanized marginal urban areas, self-produced or publicly promoted, and the accelerating of gentrification in the central areas. At the same time resistance groups emerge from civil society and from those marginal urban areas invoking the right to housing and the right to the city. In this context it is urgent to reflect on the role of academia. This communication intends to address the main reflections and actions carried out in the last two decades by the academy, in particular, by the schools of architecture and urbanism around those housing urban margins, focusing on the Lisbon Metropolitan Area and inspired by the notion of the Right to the City as claimed fifty years ago by Henri Lefebvre. It will be questioned the pertinence of the crossing of this notion of Right to the City with the most recent notion of resilience applied to the vulnerable urban margins or to the self-produced or informal city. As a case study, we will deepen a self-reflection on the research and action developed in the last decade by the Study Group of Socio-territorial, Urban and Local Action of the Faculty of Architecture of the University of Lisbon (Grupo de Estudos Socio-Territoriais, Urbanos e de Ação Local da Faculdade de Arquitectura da Universidade de Lisboa). We will underline the intricacies of its internal and external articulation with other research groups from the Faculty and other faculties, local and central government, other civil society groups, local associations and inhabitants. The aim is to identify the strengths and weaknesses of the group and its dynamics, the scope and limits of its actions in housing urban margins, in the perspective of the collective construction of the Right to the City and of a social production of knowledge. Inquiring the discourse of resilience, the aim is to broaden the discussion of what to do and how to do, calling for a more transforming and emancipatory praxis, at the level of teaching, reflection and intervention on housing urban margins.

Keywords: urban margins; Lisbon Metropolitan Areas; academia; right to the city; resilience.

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## TRACK 4C

Risk and resilience issues of the architectural heritage: documentation,  
conservation, restoration and recovery

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## Mitigating post-disaster risks to architectural heritage: lessons from Christchurch

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Since September 2010, Christchurch has suffered from several large and thousands of minor earthquakes. The impact of these on the built fabric of the city has been immense. The post disaster emergency response and recovery processes have added considerably to these losses, including the loss of the city's urban character, streetscapes, landmarks, public spaces and identity. This study reviews the impacts of the disaster response and recovery processes on the architectural heritage of Christchurch. To date, most heritage recovery and reconstruction case studies consider disaster impacts on single heritage buildings or sites and do not consider the impacts of large scale disaster on the architectural heritage of urban areas, where the scale, dynamics and focus of the response and recovery is vastly different. This study, undertaken six years after the first of the Canterbury earthquakes, is based on field observations and individual and focus group interviews with those directly involved in the emergency response and recovery of Christchurch's architectural heritage, including local and national heritage officers, architects, engineers, property owners, community members and other stakeholders. The study examines pre and post disaster factors that contributed to the losses of architectural heritage in Christchurch, and the inability of local government and heritage experts to adequately address these in the emergency situation. The study found that in the wake of the Canterbury earthquakes, emergency legislation removed the all normal legislative protections for the architectural heritage of the city leaving it extremely vulnerable. Emergency response, post disaster damage assessments and recovery planning failed to recognise the value of the city's architectural heritage to its identity and future, and authorized its destruction, even though it had the potential to be saved and rehabilitated. The study highlights the need for the inclusion of architectural heritage in emergency and resilience planning for cities, but also the need for heritage sites, government heritage officers and heritage practitioners to be much better prepared for large-scale disaster. A range of recommendations are presented for improving the protection and disaster preparedness of the architectural heritage of cities. The lessons from Christchurch should be used to improve disaster preparedness for the urban cultural heritage of similar cities globally.

**Keywords:** architectural heritage, disaster risk management, emergency response, post disaster recovery, large-scale urban disaster.

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## Historic buildings resilience: a view over envelope energy retrofit possibilities

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2018 is the European Year of Cultural Heritage, officially defined by the European Parliament and Council in May 2017. Therefore, the need of defining and promoting good practices in conservation and enhancement of historic buildings in Europe is much a current issue. In the last decades, an increasing attention has been paid to the improvement of energy performances and indoor thermal comfort in existing constructions to guarantee their reuse and keep them alive. Moreover, historic buildings, by definition durable and resilient constructions, should be prepared for the new challenges of climatic changes. The present study considers strategies, technologies and materials proposed in literature for historic buildings energy and thermal retrofit, focusing particularly on envelope refurbishment interventions. The suitability of the solutions for preserving historic valuable constructions is also accounted, mainly via considering the principle of authenticity and vapour permeability for compatibility. The efficacy of the interventions, in terms of energy savings, is then investigated. Results show that existing solutions can lead to significant decreases in buildings energy consumption, 22% to 51% averagely, but only part of them appears suitable for historic buildings preservation.

Keywords: cultural heritage, energy efficiency, envelope retrofit, resilience, restoration.

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## A methodological framework to assess disaster risks at cultural heritage sites: the case of the Roman Ruins of Tróia

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The UN's Sendai Framework for Disaster Risk Reduction 2015-2030 has emphasised the protection of cultural heritage within its disaster resilience framework, particularly in its Priority for Action 1 'Understanding disaster risk' and in Priority 3 'Investing in disaster risk reduction for resilience'. Recognising this progress, the STORM (Safeguarding Cultural Heritage through Technical and Organisational Resources Management) project aims to provide a cooperation platform for enhancing knowledge, processes and methodologies on the sustainable and effective safeguarding and management of European Cultural Heritage. Within the context of the STORM project, this paper aims to present an integrated methodology of risk assessment for cultural heritage properties facing the adverse effects of natural hazards and climate change-related events. Applicability of the proposed method to the field of heritage conservation is particularly taken into account. The paper develops a Cultural Heritage Risk Index comprising three components: 'hazard' (leading to sudden- and slow-onset disasters), 'exposure' (the elements of heritage sites and their associated values), and 'vulnerability' (susceptibility, coping capacities, and adaptive capacities), to measure the level of risks. The proposed risk assessment methodology was applied to the case of the Roman Ruins of Tróia, in Portugal. The three above-mentioned components were analysed based on the specific indicators defined in accordance with the characteristics of cultural heritage properties. The score of the components was incorporated into the risk index for measuring the level of risk corresponding to each hazard. Undertaking the assessment procedure in Tróia enables the clear identification and ranking of the natural hazards and climate change threats affecting the site, and subsequently, classifying their associated risks into the acceptable, tolerable and intolerable regions. In accordance with the STORM risk map concept, relative risk maps were generated to allow sharing a common understanding of the risks among the risk management team, including site managers and other stakeholders. The output of the site risk assessment offers a more reliable guidance on the ascription of risk treatment priorities, thus further supporting decision-making on risk mitigation and preparedness strategies.

**Keywords:** cultural heritage; disaster risk assessment; natural hazards and climate change; Tróia; vulnerability analysis.

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## Post-disaster recovery of cultural heritage at global level: evolution, challenges, and lessons learned from World Bank projects

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Since its establishment in 1944 to help rebuild war-torn Europe – supporting countries in their reconstruction and development – the World Bank has gained experience in good practices that address cultural heritage in the face of disasters and conflicts. Its approach to heritage has evolved over time, from an initial do no harm safeguard-oriented (1970-1980) progressively enriched to develop specific intervention approach (1980-2000), to finally establish an integrated approach (2000-present) integrating culture and heritage into inclusion, sustainability, and resilience of its development approach. At the same time, the World Bank has become, over the past decade, a global leader in disaster risk management, providing client countries with technical and financial support for risk assessments, risk reduction, preparedness, financial protection, and resilient recovery and reconstruction. The World Bank promotes a comprehensive, multi-sectoral approach to managing disaster risk, and its strategy supports priorities for action outlined in the Sendai Framework, as well as contributes to the achievement of the Sustainable Development Goals and the Paris Agreement. Several projects and programs illustrate the evolution of the World Bank in supporting post-disaster recovery of physical cultural heritage. Past projects include the Earthquake Reconstruction Program in the historic city of Lijiang, China, after the M 7.0 earthquake in 1996; the restoration of the iconic Mostar Bridge in Bosnia and Herzegovina, in partnership with UNESCO and other international organizations; and the cultural heritage and urban development project in five historic cities of Lebanon (Tyre, Byblos, Baalbek, Saida, and Tripoli) to establish cultural heritage as a driving force for social inclusion and economic development, becoming a good example of how a post-conflict reconstruction can evolve to support sustainable growth. More recently, projects such as the multi-hazard vulnerability assessment of cultural heritage sites in Philippines after the 2013 Bohol Earthquake and Typhoon Haiyan; the rapid assessment of the archaeological structures of Bagan in Myanmar, after the 2016 Earthquake; and the renewed and strengthened partnership with UNESCO, including the development of a joint white paper on Integrating Culture, Recovery and Reconstruction for Sustainable Urban Development, show the increasing awareness and commitment to support resilient recovery of cultural heritage. Additionally, since 2017, a technical assistance project on Resilient Cultural Heritage is being developed by the Global Facility for Disaster Reduction and Recovery, through its office in Tokyo, in the framework of the Japan-World Bank Program for Mainstreaming Disaster Risk Management in Developing Countries, and new initiatives are taking shape to include heritage in ongoing programs such as City Resilience, and Recovery Hub –which provides support on needs assessment and recovery planning to government officials and decision-makers involved in recovery process following major disasters. The World Bank has developed substantial knowledge and expertise in resilient recovery engagements helping countries assess the impact of disasters and supporting recovery planning including in fragile and conflict situations, and it is progressively including cultural heritage as a crucial sector. This paper will analyse the evolution, challenges, lessons learned, and new opportunities to mainstream post-disaster recovery of heritage at global level.

Keywords: cultural heritage; disaster risk management; resilient recovery; sustainable development.

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## Man-made risks and preventive strategies for architectural heritage under threat from urbanization

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Historic architectures are irreplaceable. They not only have witnessed human technological, cultural and aesthetic evolution, but also remain valuable resources for strengthening a community' identity and promoting the development of society and economy. Therefore, it is the responsibility of the present generation to protect this irreplaceable heritage for future generations. However, various hazards and disaster risks threaten the safety of these buildings, undermining their value. Due to urbanization, human impact on these structures is increasing. Historic architectures face various man-made risks, which increases their vulnerability. Obviously, any post-disaster recovery is not as good as active prevention. Therefore, taking measures, in advance, to prevent man-made disasters is fundamentally important. This paper focuses on man-made risks caused by inadequate urban planning and the misuse of architectural heritage sites. The purpose is to analyse the human factors that caused these risks and discuss preventive strategies for protecting our precious architectural heritage. The first part of the paper explains the attributes and values of architectural heritages, emphasizing their vulnerability to disaster risks, and the significance of architectural heritage protection. The second part analyzes the various man-made disaster risks resulting from urbanization, such as inadequate urban planning, heavy traffic, man-made ecological and cultural risks, technological risks, criminal activities and usage risks, evaluating the disaster consequences to architectural heritage with typical case studies. The third part of the paper describes the development of preventive conservation concepts. After analyzing the damage different man-made disasters impose on architectural heritage sites, preventive strategies such as proper urban planning policy implementation, urban man-made disaster risk monitoring and evaluation, architectural heritage digitalization and public participation, are proposed. Finally, the paper emphasizes the destructive power of inappropriate human activities to architectural heritage. The paper concludes that strengthening disaster risk governance, promoting real-time building and environment monitoring techniques, improving public awareness and increasing public participation are essential to reducing man-made disaster risks of architectural heritage. Through theoretical analysis and case studies, this paper discusses human-driven forces which cause disaster risks and corresponding prevention measures against these risks, making a unique contribution to improving disaster risk management mechanism and preventive conservation theory of architectural heritage.

Keywords: architectural heritage; man-made risks; urbanization; preventive strategy.

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## An indicator for the economic loss in value of damaged cultural heritage properties

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The Sendai Framework for Disaster Risk Reduction (SFDRR) upholds the development and implementation of measures to reduce hazard exposure and vulnerability to disasters. Among other aspects, the SFDRR recognizes the importance of cultural heritage and its irreplaceable value for society, thus emphasising the need to assess the impact that potential hazards may have on the built cultural heritage. Developing adequate risk assessment and management processes are fundamental towards this end and it is known that systematically collected and robust disaster damage and loss data are essential for such processes. Thus, the development of systems, models and methodologies to collect and handle such data are seen to be a current worldwide priority. One of the challenges for the disaster risk management sector is to broaden loss assessments to include non-direct losses. For example, non-monetized losses need to be integrated into loss estimation procedures to obtain a sound quantification of disaster impacts. In this context, the losses to cultural heritage and the relation between them and society (e.g. economic losses in tourism resulting from damaged cultural heritage) are particularly important but existing loss and damage databases rarely capture those effects. The topic of economic valuation of cultural heritage has been the subject of several studies over the past years and several methodologies have been developed to elicit monetary expressions of cultural values. However, most of these methods were not developed to estimate the loss in value of damaged cultural heritage properties. The quantification of the loss in value introduces an additional level of subjectivity due to the difficulty in estimating losses across the multiple types of values that are embodied in a cultural heritage property as a result of a certain amount of physical damage in the property. In this context, the proposed paper will present a methodology defining an indicator to estimate economic losses that represent the loss in value of cultural heritage properties due to damage caused by hazardous events. The methodology establishes an indicator estimating the loss in value of cultural heritage properties as a function of the (physical) damage they suffered and of the positive estimated economic impact that cultural heritage has in a given country. This indicator is not meant to reflect the true value of economic losses. Instead, it reflects a standardized measure of potential economic losses that is comparable across countries. Details of the methodology are provided along with its potential applications within the SFDRR.

Keywords: cultural heritage, cultural heritage damage, cultural heritage loss, economic loss indicator.

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## First processing and remarks on the observed damage to the churches of the Marche Region after the Centre Italy Earthquake 2016

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The seismic sequence that struck Central Italy since August 24, 2016 caused serious damage to many buildings of historical and artistic importance. In particular, churches were widely damaged due to their intrinsic peculiarities concerning the structural system, not able to develop an efficient box-like resisting mechanism. Their architecture is characterised by recurrent structural subsystems, e.g. façade, side walls, transept, apse, nave and side aisles, which tend to exhibit often independent seismic responses and commonly indicated as macro-elements. Studies carried out on damages occurred to churches following the Italian earthquakes demonstrated that the damage mechanisms have recurrent characteristics, despite the uniqueness of each building. During a seismic emergency, teams of experts carried out inspections on the churches in the areas interested by the seismic event with the aim of assessing both the significance of the occurred damage and the current safety. The team has been coordinated by the Department of Civil Protection (DPC) and the Ministry of Cultural Heritage and Tourism (MiBACT) through the executive department operating within the Command and Control (Dicomac) and the regional offices of MiBACT. In this paper, data recorded on the A-DC forms during the inspections are processed for a sample of churches of the Marche region. The A-DC damage survey form, collecting general data of the building (name, geographical position, historical dating, contained mobile goods, etc.), data of the planar-volumetric organization of the main elements of the building (e.g. central nave, apse, transept, façade) and its state of conservation and in a specific section of the survey form, the macro-elements that can be potentially activated, their relevant level of occurred damage and the nature of the damage (seismic or non-seismic) are addressed. Starting from the analysis of the sample, a methodology for processing data is presented; this can be applied in the future to the whole set of data. Starting from the subdivision of the sample into homogeneous typologies, the most recurring damage mechanisms are determined. In addition, the global damage indexes of each church are correlated with the relevant highest Pseudo Spectral Acceleration at 0.30s registered at the site as a consequence of the main shocks; this allows obtaining relationships between the seismic intensity and the expected damage. Finally, the overall damage occurred to churches of the sample is compared to that estimated through empirical models available in the literature, which are developed on the basis of data recorded after the 1997 Umbria-Marche Earthquake.

**Keywords:** Central Italy earthquake; cultural heritage vulnerability; church damage mechanisms; damage indexes.

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## Welcoming floods in the Santa Clara-a-Velha heritage site

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The notion of built heritage is often associated to outstanding and valuable elements that have been resisting time, despite the potential threat of disappearing. Moreover, some remarkable historical buildings and complexes are also located in hazard-prone areas, a fact that constitutes an additional challenge for their perpetuation. In these particular cases, we argue that the heritage status held by these structures can be associated not only to their particular historical and cultural values and meanings, but also to their role as reminders of living with the latent risks. This paper focuses on the integration of disaster risk reduction into the conservation, restoration and recovery of heritage sites. In particular, it examines how floods have been dealt with throughout the lifetime of the Monastery of Santa Clara-a-Velha (Coimbra, Portugal), a historical monument that was recently targeted by a requalification project, following the significant modifications of the Mondego River's regime by regulation works in the 1980s. This Portuguese national heritage complex illustrates a long-lasting intricate relationship with the river's waters since its foundation in the 14<sup>th</sup> century, in which resistance, resilience, retreat and resignation strategies were successively favoured. Having been partially submerged for centuries, the ruins of the Monastery (the church and the associated cloister) were finally brought back to a dry environment in the beginning of the 2000s, thanks to the construction of a cofferdam around the complex. Outside the cofferdam, a new structure to host a museum for the related archaeological findings was built, elevated on stilts. The research intended to highlight the prevalent mindset and flood-risk culture underlying the most recent intervention in the monument site, and therefore adopted the case-study method, involving desk review, interviews and in loco observations. Our analyses of the process suggest that although risk mitigation was clearly dealt with by the stakeholders involved in the requalification project, a contingency plan has not been properly considered to anticipate the possibility of the heritage complex functioning during and rightly after flood events. For instance, as a consequence of the two 2016 winter floods, the complex remained inoperative for almost three months. Yet, we consider that the design could have explored the possibility of 'welcoming floods' and thus assessed the feasibility of visiting the Monastery's premises while submerged, temporarily offering its visitors a privileged, unexpected and fascinating occasion to experience the flooded monument, just as it used to be for centuries. This opportunity could have represented a ludic and pedagogical possibility to explore interconnections between history and memory, while floods would actually give continuity to the former.

Keywords: built heritage; Monastery of Santa Clara-a-Velha; flood adaptation; risk mitigation through design.

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## The Washington National Cathedral: post-earthquake recovery of a neo-gothic cathedral

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The Mineral, Virginia Earthquake on August 23, 2011 damaged a number of historic masonry structures throughout the District of Columbia to varying degrees. Of these, the Washington National Cathedral, a heavily-visited tourist destination and functioning house of worship, sustained some of the most significant, visually striking, and potentially dangerous damage. The Cathedral, whose construction began in 1907, is an unreinforced stone masonry structure in the Gothic Revival style characterized by an abundance of flying buttresses and carved stone pinnacles and turrets at various elevations over its 330-foot height. Many of these elements partially collapsed or became unstable during the earthquake. Once imminent falling hazards were removed or stabilized, the process of assessing the extent of damage via rope-access and developing conceptual schemes for mitigating the damage began. Due to insufficient available funding to repair the damage in the near-term, a long-term strategy was needed to allow for continued occupancy of the Cathedral in light of the presence of displaced heavy stone masonry at great elevation and for phasing the repair and restoration of the fragile gothic elements. In developing the strategy, questions were raised regarding whether and when the damaged elements should be strengthened – so as to not increase the hazard by integrating multiple masonry courses and creating heavier potential falling hazards – and how best to develop practical criteria for strengthening. Simple and direct seismic assessment approaches were developed and utilized. The earthquake had already provided full-scale evidence of the behavior of the Cathedral under design level ground shaking; the most vulnerable elements and types of elements were the most damaged, and the elements needing less attention were undamaged. At the same time, the observed behavior provided direct physical evidence of the transfer functions through the structure. Quantification of these transfer functions proceeded without development of a complex global model that would have itself introduced many uncertainties, and these enabled the development of targeted repairs to vulnerable ornamental elements that were “tuned” to their risk of future instability, as well as to the magnitude of the falling hazard associated with instability. Over the last several years since the earthquake, the Cathedral response team is following through with an approach to the exterior restoration process that balances repair of seismic damage with deferred repairs and long-term maintenance needs, as well as opportunities for fundraising. By appropriately prioritizing the exterior repair requirements, the overall restoration is on its way to successfully integrating non-seismic improvements and leveraging needed access to the exterior and interior, while attempting to consolidate disruption to Cathedral operations, and safely phasing the work schedule to better match the anticipated funding stream. This paper will describe the philosophy and methodology of the assessment and interventions, as well as layout the passage from the initial catastrophic damage state toward restoration. It will also highlight particularly remarkable examples of damage and the resulting retrofits for various cathedral elements that demonstrate how the damage observed has informed the development of the retrofit designs.

Keywords: earthquake repair, limited retrofit, historic preservation.

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## Some remarks on a rational and interdisciplinary approach to the safety and conservation of historical centres in Abruzzo Region

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In the last decade, Central Italy was struck by very long earthquake sequences and suffered heavy damage caused by events characterised by high magnitude. This is the case of large in area in the Lazio, Marche and Umbria regions hit by the sequence started in the summer 2016 and the Abruzzo hit also by the L'Aquila earthquake occurred on April 6<sup>th</sup>, 2009. All these events impacted on a very complex territory characterised by a few highly urbanised areas and small towns fragmented in many minor municipalities and small villages. In such a context, the primary matrix of the built environment is the historical one; each settlement is generally associated to relevant architectural and landscape features founded on consolidated history of the area. From such a perspective, the problem of the conservation and of the resilience of minor historical centres and settlements in the Central Italy is becoming a key issue at International level due to the strong interrelation between cultural, social, technical and financial aspects. This is the background of this paper that moves from the assumption that lessons learned from the implementation of measures able to recover the built heritage, and more generally the territory in the L'Aquila area following the 2009 earthquake can be useful to refine some interdisciplinary problems like the knowledge of the built environment in view of performance assessment and the definition of monitoring protocols aimed at preserving the construction during its ordinary life, but also in the event of earthquake sequences. In order to avoid a too general statement of the problem and also to perform a validation of the envisaged interdisciplinary approach to the problem, the attention of this contribution is focused on some historical and construction peculiarities that can be found in the Abruzzo region, namely the fortified sites. The region is rich in castles, towers and fortified enclosures that have undergone numerous transformations over time. Some of these have developed creating the magnificent villages that, with their fortified residences, define the territory, others have been abandoned becoming suggestive ruins of which, still today, can be appreciated the main features, namely the ancient city walls interrupted by several defensive towers. It is a topic that appears worth investigating due to the specific nature of the construction, but also because in many cases these typologies represent the early core of many small villages distributed in the area. Historical and architectural features of the construction of interest are analysed by means of the traditional methods adopted in the context of restoration processes; historical, architectural, constructive and structural knowledge are however reviewed and discussed in the light of the interventions eventually designed and/or made on selected structures after the 2009 earthquake. The results of a kind of SWOT analysis are presented in order to provide a contribution in the development of advanced tools for protection of historical heritage from environmental hazards.

Keywords: architectural heritage, minor historical centres, seismic vulnerability, structural monitoring.

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## Cyclic behaviour, dynamic analysis and seismic vulnerability of historical building archetypes in Hungary

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Hungary is located in the Carpathian Basin, a region with a regular low-to-moderate seismicity and a relatively small occurrence rate of high-intensity events. Most of these events happened before the advent of modern seismology, leaving damage records that enable the study of their effects on structures. A method for the estimation of the magnitude of historical seismic events exists and uses Dynamic Structural Analysis (DSA) to produce fragility functions. The Bayesian framework of the method allows to incorporate physical and epistemic uncertainties of different sources in the final magnitude estimates. Hence, to obtain reliable magnitude estimates it is important to reduce the uncertainty in both structural resistance and demand. This requires different investigation levels on the building typologies, the materials, the collapse mechanisms, and the ground motion (GM) patterns of the affected region. Despite the historical buildings investigation, the incorporation of uncertainties in the structural models requires considerable computation. This paper studies the effects of the 1763 Komárom Earthquake (Western Hungarian Kingdom), by the Nonlinear Static Analysis, together with the EC8 N2-method, and DSA, Incremental Dynamic Analysis (IDA), of 8 historical building archetypes characterizing the building and material variability and 30 selected GM records. The physical uncertainties are incorporated using Monte-Carlo Simulation and an OpenSEES Pinching4 hysteretic material model is calibrated for IDA. The resulting fragilities show relatively high damage probabilities at low acceleration levels.

Keywords: historical earthquakes, masonry structures, dynamic analysis, seismic vulnerability, archetypes.

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## Architectural heritage of Sri Lanka: post-disaster lessons learned

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During the last two decades, Sri Lanka faced many natural and human created disasters which had a strong impact on the Archaeological and Architectural Heritage of Sri Lanka. The Boxing Day Tsunami of 2004 had a great impact on the architectural heritage of the coastal areas of Sri Lanka. The 30 years of war in Sri Lanka also had many repercussions on the Heritage Architecture including World Heritage Sites which were targeted for attacks. Sri Lanka also faces floods, landslides and droughts but these disasters have a minute impact on heritage architecture and therefore not considered in this paper. This research is based on my post Tsunami and during and post war documentation of heritage architecture of Sri Lanka. Heritage in this context is defined as structures which were constructed more than 100 years ago, culturally important architecture and archaeological sites. This research is two-pronged with the impact on heritage buildings and sites as a result of natural and man-made disasters were carried out. The impact of Tsunami on heritage architecture was carried out in the coastal areas of Sri Lanka, especially along the Eastern and Southern Coast. The survival and the destruction of the buildings were identified and reasons for each analysed in depth including conservation methods, etc. The analysis also includes damage to heritage structures and archaeological sites during the post-Tsunami period due to the internally displaced persons. The prolonged war situation in Sri Lanka and heritage architecture and archaeological sites were targets for destruction and the causes were also studied in detail. The damages to heritage sites in the Northern province of Sri Lanka was studied in terms of targeted destruction and accidental destructions due to the state of war. Survival of heritage architecture in a state of war was discussed with local inhabitants and their opinions documented as far as possible. The information gathered was analysed. The disaster impact on heritage is varied. The impact and the damage caused by Tsunami was based on strength of the wave, vegetation around the structure, conservation methods, distance, etc. The cultural heritage architecture including more recent buildings of cultural activities received presented a comparison point. The heritage architecture during the war had two categories. One was the intentional targets and the other was the unintentional impacts of war. Both caused damage throughout Sri Lanka and the causes for these damages and endurance were multi-layered. On one hand, the heritage architecture was selected as targets to have a maximum impact on the population and the other was always accidental even though the both caused damage. The results of this research also laid the foundation for recommendations for heritage architecture during disasters.

Keywords: Sri Lanka; tsunami; war; cultural heritage.

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## Protecting cultural property in armed conflict and following natural disasters: the work of the Blue Shield

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The Blue Shield is the international NGO set up in 1996 to advise UNESCO on the protection of cultural property in the event of armed conflict. The organisation is committed “to the protection of the world’s cultural property, and is concerned with the protection of cultural and natural heritage, tangible and intangible, in the event of armed conflict, natural- or human-made disaster” (Article 2.1 of the 2016 Statutes). While many argue that cultural property always gets damaged and destroyed during conflict and there is little that can be done, the paper will discuss the Blue Shield’s view that such damage and destruction is frequently avoidable and has been seen as bad practice by military theorists for over 2,000 years. The paper will provide a brief review of the history of cultural property protection that culminated in the Allied Powers in the Second World War acknowledging the importance of protecting cultural property by creating the Monuments, Fine Arts and Archives Sub-Commission (MFAA). Unfortunately, the MFAA team was largely broken up at the end of the war and, despite the 1954 Hague Convention on the Protection of Cultural Property in the Event of Armed Conflict and its two Protocols of 1954 and 1999, the military - and heritage community - essentially forgot the importance of trying to protect cultural property during conflict. It was only following the disastrous destruction and looting that followed the war in the former Yugoslavia and the 2003 invasion of Iraq that the issue returned to the agenda. The paper will then go on to outline how the Blue Shield works with the military and other relevant organisations to raise the profile of cultural property protection and how, through proactive protection and resilience building, it aims to mitigate the impact of armed conflict and natural- or human-made disaster. Progress has been slow but recently significant steps have been taken.

Keywords: armed conflict; natural disaster; the Blue Shield; 1954 Hague Convention.

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## Seismic assessment of the National Palace of Sintra: a multi-disciplinary approach

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The presence of important built heritage in Lisbon and surroundings, a seismically-prone area, requests always greater measures to protect them. The Nacional Palace of Sintra, a complex structure composed of different unreinforced masonry buildings, is one of the most ancient palaces in Portugal, based on Arab foundations. It has survived to the 1755 Earthquake, although some parts were reconstructed at the time, and to the 1969 Earthquake, that caused some visible cracks and pavement settlement in the Bonet building (belonging to the most ancient part). In order to perform a complete and adequate seismic assessment of the Palace, a collaboration was developed with several multi-disciplinary expertise: structures, construction and materials, topography and architecture. A historical approach was developed, before conducting experimental tests, by studying the history of the Palace and its construction evolution in detail. After this study complete, it was possible to define the most appropriate places to retrieve specimens of the walls. With these samples, and after laboratory tests, it would be possible to characterize the type of construction by date, the type of materials and its own properties, what represents a really important step for the seismic assessment of the structure. In addition, double flat-jack tests were also carried out in most of the places where samples were removed, with the aim of evaluating the mechanical properties of the masonry (e.g. compressive strength, Young modulus) to implement in the numerical model. Complementary to the other above-mentioned tests, a Ground Penetrating Radar (GPR) survey, an innovative non-destructive test, was also performed to characterize the masonry not only where samples were retrieved, but also in pavements with vaults and walls that are built against the bedrock. Different frequency antennas allowed to discover construction techniques, types of material, anomalies (e.g. voids, cracks, water). For the dynamic characterization of the Palace, ambient vibration tests were also performed in different blocks of the structure, contributing to the development of a calibrated numerical model. The process of calibration (mechanical properties) is expected to be one of the major difficulties since there is a large number of uncertainties despite the experimental tests performed. From an architectural and topography point of view, a 3D model of the Palace in BIM (Building Information Modelling) is also being created and printed to increase the existing visual data of the Palace and to support the numerical analyses. In the near future, a 3D laser-scan survey will be carried out and information will be included in the already developed 3D BIM model. The present paper addresses the above-mentioned in-situ tests performed and presents the first numerical results with the aim of evaluating the seismic safety of the National Palace of Sintra, within an R&D project for the identification of structural anomalies and vulnerability factors. This study is coordinated by Instituto Superior Técnico and promoted by Parques de Sintra – Monte da Lua, SA. In a later stage, the seismic action to consider for the nonlinear analyses will be defined together with PSML, considering different impact factors and the national code.

Keywords: seismic assessment; masonry historical buildings; ambient vibration tests; double flat-jack tests; GPR.

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## Analysing the cost-effectiveness of heritage-conservation interventions: a methodological proposal within project STORM

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Cost-Effectiveness Analysis (CEA) may constitute a valuable decision-support tool to allocate cultural heritage preservation resources, allowing policy comparisons without the need to monetise the expected outcomes which, in heritage contexts, are largely made of non-use values and inherently difficult to price. Nevertheless, its application in the heritage sector is still limited, arguably due to difficulties in ‘effectiveness’ appraisals. STORM (Safeguarding Cultural Heritage through Technical and Organisational Resources Management) is an H2020-funded project for the development of Disaster Risk Management solutions for heritage sites facing natural hazards and climate change. Within its scope, a methodology for the CEA of conservation interventions was developed and applied to the Roman Ruins of Tróia (Portugal), the remains of the largest known fish-salting production centre of the Roman Empire, one of STORM’s pilot sites. This paper describes the CEA methodology, including cost and effectiveness indicators and discount rate: some directives are suggested for listing the costs associated with conservation interventions; and guidelines are offered for the assessment of effectiveness, based on the compatibility of the foreseen actions with heritage materials and cultural values, and on the training of the professionals involved. Effectiveness appraisals should be undertaken by a sufficient number of relevant experts, so as to allow the obtaining of a measure of uncertainty, corresponding to the standard deviation of the expert assessments. To ensure that cultural values are safeguarded, it is additionally recommended that an effectiveness tolerability threshold is put forth, below which no actions should be chosen. The paper furthermore reports on the methodology application for the assessment of five strategies to control the risks of a sand dune weighing upon the walls of a well in the largest workshop of the Roman Ruins, Workshop 1. The strategies varied in terms of approach (preventive and remedial) and in terms of fabric interference (different degrees of maintenance). The CEA showed that ordinary maintenance options are costlier, but more effective, than extraordinary maintenance ones; it additionally confirmed that remedial strategies are not only costlier, but also highly ineffective when it comes to the conservation of the cultural significance of archaeological assets, largely reliant on the preservation of original materials. The most cost-effective option was the less intrusive strategy, matching current perspectives on archaeological conservation, and seemingly indicating that the procedure is robust. Applications to other conservation actions, e.g. emergency interventions, in the remainder STORM pilot sites, will allow further validation of the methodology.

Keywords: archaeological heritage conservation; cost-effectiveness analysis; disaster risk management; project STORM.

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## Multi-scale assessment and mitigation of fire risk in urban areas: the old city centers of Guimarães and Quito as case studies

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Urban risk mitigation is a priority in cities management due to the severe consequences and costs that disasters can carry on. Despite the fact that actions are usually intended on post-disaster situations, several efforts are focused in prevention through the definition of pre-disaster actions, especially in high vulnerable urban areas. In that sense, historical centers represent one of the main challenges for risk mitigation due to two inherent characteristics: their heritage value, related with their historic importance, economic role and social symbolism; and their high vulnerability, due to their condition of old urban areas, usually complex in terms of architectonic, constructive and urbanistic development. Considering the abovementioned, the present investigation is focused on fire risk assessment of two historical centers: Quito, the capital city of Ecuador, and the city of Guimarães, Portugal. Both assessments are based on the application of a simplified index-based approach specifically developed for assessing fire risk in old urban centers. Since Quito case study is at least 20 times bigger than Guimarães, a multi-scale adaptation had to be considered in order to encompass this great difference. Thus, Guimarães case study is analyzed in a neighborhood scale, with a building-by-building assessment, considering the characteristics, conservation state and settlement features of each construction. As for Quito case study, it is analyzed in an urban scale through a neighborhood-by-neighborhood assessment; in this scale, the analysis is carried out through a selection of representative buildings of the neighborhoods. Besides, urban morphology, building characterization, demographic data and fire management capacity are obtained from previous research works carried out in the city of Quito, including risk analysis studies and census data. Both of the assessments include the integration of the results into a geographical information system tool (GIS), through which urban risk is adapted and analyzed in spatial terms. The present investigation intends to set the first step towards the application of real interventions to reduce urban vulnerability. The results presented aim to constitute a practical tool, addressed to city councils and local authorities, that can be used to support the development of more comprehensive and efficient fire risk mitigation actions. Among the main conclusions, the results revealed that only 6% of the buildings evaluated in Guimarães case study present low level of vulnerability against fire, which means that the majority of buildings are currently in an “unsafe” situation. Results also indicate that this vulnerability is mainly related to accessibility and evacuation aspects, both inside and outside the buildings, which, to a large extent, result from the characteristic of the buildings and the old city center itself, not designed to comply with the current safety standards. Regarding Quito case study, neighborhoods San Sebastian, El Placer, El Tejar, La Chilena and San Diego were identified as the most vulnerable, among 14 neighborhoods analyzed. Finally, the key role of documentation in the domain of multi-scale risk assessment is critically discussed taking into account the source of the information and the specific challenges found in each case studies.

Keywords: fire risk, multi-scale risk assessment, historical centers, old buildings.

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## The 8<sup>th</sup> ICBR Lisbon 2018 publication outputs and the contributions of the Special Session and the thematic track on Architectural Heritage: Special Issues and Elsevier books

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The presentation focuses on the announcement of a Special Issue of an indexed journal that will be based on a selection of papers presented in the Special Session on Architectural Heritage and in the associated track. The conceptual and thematic framework will be discussed with regard to the 8<sup>th</sup> ICBR's motto – Risk and Resilience in Practice: Vulnerabilities, Displaced People, Local Communities and Heritages –, and taking into consideration the pieces of research submitted in each track. Also will be addressed the possible gaps in the literature produced through the most prestigious journals of the area and how this Special Session could try to fill them. In this sense, considering other publication outputs of the 8<sup>th</sup> ICBR and the goal of addressing some of the timelier and pressing matters of academia, and the social and humanitarian sectors, a first analysis points to the need for launching a call for papers open to the ICBR audience and beyond, to ensure that the goals of this Special Issue are met. Furthermore, in similar terms but in this case looking at the titles and foreseen contents, as well as the expectable larger audience to be achieved, it discusses a possible call for papers for the planned Elsevier books, remarking the differences, in terms of subjects and approaches, of the four books.

Keywords: 8<sup>th</sup> ICBR 2018 publication outputs, Special Issues, book chapters, Elsevier books, call for papers.

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## TRACK 4D

Anticipating and responding to forced displacement: focus on people

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## Refugee participatory design for shelters: experiment in Jordanian Syrian camps

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There are around 666,000 Syrians who are registered as refugees in Jordan. As of May 2018, approximately 120,000 are hosted in the two largest camps in Jordan; Zaatari and Azraq. Various articles and reports have found a variety of issues arising from the metal one-room shelters that are provided to the refugees in those camps. This work is part of a research about the architecture of emergencies in the Middle East. A key finding of this study was that community participation is a very important step towards an enhanced shelter design. Participatory Design (PD) is one way to engage the users of the space in the design development process for current but also future shelter habitat. However, there are also challenges in how to form a technique that is easy to use for non-designers and allow them to contribute with their unique input. In a step towards proposing a future designed shelter for Middle Eastern refugees and displaced people, experimental participatory design sessions were held with 43 residents from both Zaatari and Azraq camps. The main objectives of the experiment were to understand the residents' priorities, how they use the space, the functionality and to address issues they had identified from current camp experience. A further aspect of the study was to identify how cultural and social dynamics affect the choices of the participants. The study included men, women and children in order to have a range of users input. The sessions were structured firstly with discussions about the experience of living in shelters, what were their expectations before arriving at the camp and what are the challenges they face in their current shelters. Participants in each session agreed on a list of activities they typically undertake inside their shelters and require space. Three groups in Azraq and six groups in Zaatari were given sets of prepared materials to form 3D mock-ups of their preferred shelter design. The fourth group in Azraq drew a 2D plan instead. The mock-ups were then transformed into 2D plans to prepare them for analysis and comparison. Findings showed that most designs had a similar approach to function. There were no clear differences between the outcomes when comparing the different camps' responses, but they were found in terms of participants' gender. Main differences included the courtyard size, the number and position of entrances, the size and position of windows, number of rooms, and function relationships. The main factors which influenced the participants' design decisions were culture and privacy. The experiment showed the importance of participatory design in knowing the users' needs while empowering them at the same time. Finally, it was found that a degree of flexibility is preferred in any given design to allow the residents to add their identity to their shelters and thus increase their feeling of attachment to the designed habitat.

Keywords: participatory design; Syrian camps; shelter design; gender differences; refugee.

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# The emergency cycle in Ecuador after the 2016 earthquake: the importance of reintegration and contextualization from emergency camps to permanent housing projects

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In the aftermath of the tragedy, the population affected by panic and prostration eagerly accepts the help that is available. Governance, NGOs and even small associations are often praised about their input during the emergency phase but criticized in the transition from the first into the recovery phase. Frustrations, indignation and disapproval by their potential beneficiaries are due to the lack of comprehension of the real needs of the people and to actions and projects that are not contextualized. In addition, investments and financial aid given during the emergency phase - should be used for contextualized actions that lead to the recovery phase. This article is based on experiences of emergency aid actions in the coastal region of Ecuador after the April 2016 earthquake, following which various types of emergency solutions were put in place. Based on empirical research mirroring ethnographic approach in the village of Canoa and the city of San Vicente, interviews with displaced families were conducted after the end of the emergency phase in August 2017. At the beginning, the first purpose of those surveys was just to highlight the distinctions between formal and informal camps, in regard to the quality of shelter construction in the emergency phase. But at site, after interviewing the displaced people, it was possible to understand the families housing situation before, during and after the hazard, and the new goal was to find evidences about their experiences during all those phases. Moreover, by questioning the displaced people, the effectiveness and relevance of first phase of emergency and the reintegration solutions were questioned and criticized. These interviews showed that the rights of the displaced people and the rules of the camps during the emergency phase were relevant factors to evaluate living quality in those spaces. Furthermore, the quality of temporary constructions and different uses of camps are relevant when faced to permanent solutions created after the emergency and transitional phase. During the emergency phase, it is difficult to understand the actual needs and concerns of displaced people, and it is also challenging to assist decision makers and other actors to avoid ineffective and decontextualized actions. Collaboration and exchange of information among actors using contextualization researches from camps to reintegration projects, can lead to more pertinent solutions and to aid building a resilient community. The main objective of this study is to highlight the concept of contextualization as a key issue for a better understanding of reintegration and one that should be present since the emergency phase.

Keywords: natural disasters; emergency cycle; camp projects; temporary housing; permanent housing.

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## Temporary and decentralized approaches in protracted refugee situations: the case of the Syrian refugees in Lebanon

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Refugees' displacement lasts on average almost two decades before they manage to repatriate, resettle or integrate in the host state. Yet, host countries and institutions persist in dealing with refugee situations as temporary crises, adopting policies based on exclusion designed to spur refugees' prompt resettlement or repatriation. Lebanon's strategy towards the ongoing seven-year Syrian refugee crisis is no exception. Yet, the Lebanese response represents two particularities. First, despite the overwhelming number of refugees, Lebanon has adopted a non-encampment policy. This aimed at avoiding the experience of Palestinian camps, which evolved into militarized spaces outside the governance of the Lebanese state. Second, the Lebanese Government has assigned the management of the crisis to municipalities, leading to decentralized policies varying from exclusionary to tolerant and permissive. Thus, refugees concentrated in areas where authorities are lenient, settling informally and bringing about significant transformations in the urban and rural landscape. The sudden population growth in these areas has strained the already precarious economy, infrastructure, and services, and caused an imbalance in the social fabric and the delicate sectarian stability. This study examines the reasons leading to current Lebanese policies. It evaluates their impact on the number of refugees hosted, the modalities and types of settlements, and on resulting economic and social conditions. The analysis was carried out through two case studies in areas with high refugee density: First, an Informal Settlement in Dalhamieh, a rural village with vast agricultural land under the authority of the municipality of Zahleh in the Bekaa governorate. Second, in Nabaa, a densely populated and poor urban neighborhood on the outskirts of Beirut, administered by the municipality of Burj Hammoud. Data was directly collected between 2015 and 2017 through field observation, semi-structured interviews, and group discussions with more than 50 stakeholders including municipal authorities, camp managers, community members, and refugees. Results show that the municipality of Zahleh, reluctant to manage the crisis allowed settlements, provided they remain 'invisible' and remote from the city. This was advantageous to refugees who formed a homogeneous community where they felt secure and kept their traditions and culture. On the downside, the settlement is causing serious environmental challenges and dwellings are difficult to maintain in the winter. As for Nabaa, most landlords do not easily comply with municipal rules. They replaced local tenants with Syrians who pay higher rent. Currently, 80% of residents are Syrians and due to competition for housing and jobs, inter-communal tensions are dangerously growing. In both models, Syrians suffer from exploitation and frequent evictions. Findings confirm that temporary approaches aiming at the exclusion of refugees increase their vulnerability and delay their repatriation or resettlement. In fact, the LG's decentralized approach and their unwillingness to actively address the crisis as a protracted one in terms of planning and organization, and the disparities in local policies have led to the formation of informal, uncontrolled, and vulnerable urban and rural Syrian ghettos, an outcome that the LG, by prohibiting camps, was trying to avoid at all costs. These ghettos are often located in the poorest areas, where given the decrease of international humanitarian assistance, authorities and residents are unable to handle demographic, economic and social pressures.

Keywords: Syrian refugees, Lebanon, temporary approaches, decentralization, protracted refugee situations.

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## Housing, land and property issues of Syrian refugees in Lebanon originating from Homs City

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This study explores housing, land and property issues affecting Syrian refugees in Lebanon originating from Homs city in the context of a crisis entering its 8<sup>th</sup> year in 2018. Given the non-encampment policy adopted by the Lebanese Government since the beginning of the Syrian displacement, the objectives were to study the means (and how they changed) that refugees are using to secure shelter in a protracted crisis, in addition to shelter conditions and security of tenure. Access to housing was studied in light of social networks between Syrian refugees and local host communities that predated the crisis, and within changing legal hosting policies that have tightened the grip on the legality of their presence in Lebanon. The research methodology adopted an extensive literature review on urban refugees and the Lebanese context, and data analysis using a mix of quantitative (household survey) and qualitative data (focus group discussions and key informant interviews), focusing on the population of refugees that have been displaced from the city of Homs to Lebanon as a study sample. Findings indicate that strong pre-war community ties facilitated Homs refugees' access to housing and helped maintain a certain level of stability. However, these ties have been strained through the protracted crisis, pushing refugees to rely heavily on informal rental markets. These markets operate outside any regulatory framework that monitors rent hikes and protects refugees from evictions. They have been able to supply housing since the beginning of the crisis and are widespread in low-income urban and peri-urban areas. Refugees' vulnerability amidst a predatory informal market is further aggravated by the hosting legal framework which has hindered their legality, mobility and ability to work. Consequently, the study identified the role of different stakeholders in responding to the refugees' crisis in Lebanon, assessing their impact and limitations. One interesting characteristic found in the studied sample is the low reliance on aid from INGOs, namely aid in the form of housing assistance. This finding can be read as an indicator of agency, resilience and the ability of the informal market to absorb rising housing needs, on one hand, but on the other hand, an indicator of increasing risk of impoverishment in a protracted crisis for a population with fragile work opportunities. Hence the urgent need to adopt a sustainable approach to enhance refugees' livelihood and protect their HLP rights in the host country.

Keywords: Lebanon; Syria; refugees; housing; protracted.

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## TRACK 4E

**Informal settlements: rethinking the role of design and planning in  
paths towards the development of urban resilience**

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## How to design incremental housing: in search for a building typology of evolutive architecture

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Unplanned and uncontrolled, the informal city is the result of a sum of several individual actions and arises in many of the world's great metropolises. The city is then built out of the legal scope, thanks to the own inhabitants initiative. But, despite the strong self-organization among families and communities, informal housing can't be considered a complete answer for building sustainable cities. Often built on wastelands, the informal city is prone to significant natural hazards and the absence of planning can have serious long-term consequences, in terms of sanitation and structure mostly. To ensure at the very least that residential units function correctly in structural and sanitary terms, it is essential to tackle the problem globally. Hence, within the framework of an incremental-housing project, different roles are allotted to the inhabitants and to the architects: the professionals focus on planning an adequate urban fabric, as well as designing the technical core of buildings in order to facilitate and incorporate the extensions carried out by the inhabitants over time. Our role as architects is no longer to build the façade but the core, the parts that require technical knowledge. By allowing the hybridization of formal and informal strategies, incremental housing appears to be a relevant alternative to tackle the mass-housing issue. However, this building strategy isn't yet widespread among the architects' community. This investigation therefore aims to provide a set of tools for architects and urban planners for them to incorporate incremental housing as part of their professional practice. To achieve this, the investigation covers a large corpus of incremental houses retrieved from two main architectural experiences. On one hand, the recent work on large scale social housing headed by the Chilean office Elemental; and on the other hand, the unique allotment operation PREVI (Proyecto Experimental de Vivienda) developed in Lima in the late 1960s. Both projects are based in Latin America and face similar urban challenges. By comparing these two experiences and by looking at the evolution of the houses over time, the investigation provides an incremental housing types catalogue. This inventory is a mean to understanding incremental housing and provides guidelines and tools to keep improving its design quality. The results reveal the existence of several architectural approaches to design incremental housing that can be translated in different categories. This catalogue is an endless process that needs to be updated with new innovative approaches. The informal city is constantly growing, revealing an important need for housing. Thus by considering this phenomenon not as a problem, but as an incomplete solution, architects can design accurate solutions in order to support the urban growth. The house is built gradually, as needs and money arise, and the unexpected is incorporated or even encouraged in the initial design. We believe that incremental housing will turn into a widespread idea and become a common tool for tomorrow city planning.

Keywords: incremental; informal; evolutive; housing; typology.

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## Poverty-reduction strategies in slums and ghettos: Bucharest as study case

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Research is based on projecting a new type of public policy regarding fight against poverty in urban areas, found in the outskirts of the former working cities of Romania. This public policy is part of the planning process of a new national strategy of eradicating poverty, the main goal being operationalizing it. From a regulatory point of view, the implications will be architectural and urbanistic, the main goal being changing the urban form, which can play a big role in combating poverty. The reason I chose to focus on ghetto poverty is that in recent studies performed by Romanian sociologists, the ghetto stands out from the other disadvantaged urban areas in Romania (junkyards and historic center areas), having the highest index of extreme poverty and crime. The most dangerous ghetto in Romania can be found in Bucharest, in Ferentari neighborhood, this being the subject of the research. As it stands, there is no public policy regarding fight against poverty and social exclusion, but there is a national strategy that only highlights the social problem, being totally not connected to NGO's that focus in the same direction, only on their own. Therefore, the main research objectives have been set accordingly: (1) trying to connect the alternative strategies suggested by NGO's at the National Strategy regarding fight against poverty; (2) implementing principals of architectural-urbanistic within the previous objective, developing this way a new hybrid strategy, containing both non-spatial interventions and spatial interventions; (3) trying to extrapolate a new strategy for all ghettos from around the country. The research methodology uses three types of instruments, chosen according to three main objectives: (1) bibliographic research, in which I discovered the actual status of the research; (2) comparative analysis of data, by identifying statistical data and comparing those in the interest of finding similarities and differences; (3) social inquiry, using polls and interviews, questions being sorted in specific sections regarding groups of people interviewed. The policy making process will follow the 6<sup>th</sup> steps of Thomas Birkland: agenda setting – first stage of the process, in which is presented a wide array of solutions; policy formation – filtering the solutions; policy legitimation – the government establishes a set of actions based of the policy chosen; policy implementation – applying the decisions using tools for the fund and the procedure; policy evaluation – results of the policy are being monitored; policy maintenance or succession – once implemented, policies are appreciated based on relevancy they have and efficiency, continuing them or modifying it, as per case. In conclusion, the research is intended to create a new hybrid strategy, meaning to stop poverty in Bucharest ghettos, at the same time implementing a new public policy.

Keywords: urban poverty; ghetto dispersal; public policy; architectural approach; education.

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## Risk and urban design in *favelas*: the close relationship between participation and territorial management

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In the 1990s, Brazil began to implement an integrated slum upgrading policy to mitigate urban conflicts and risks. The Urban Design Project has served as the basis for making intervention decisions. Within the field of urban design in *favelas*, the studies that have been developed are focused on the search for new parameters and intervention methodologies. Thus the project continues to be considered as a powerful agent that generates transformations of these settlements. But how has the resilience responded to the urban special design in slum upgrading programs? Our PhD research analyzes and discusses the urban design project in Brazilian *favelas* in different aspects – such as mitigating risks and integrating the settlements into the city. The goal is to define the challenges, limitations, results and categories of the urban spatial design in *favelas*. This will provide parameters to strengthen the design and to enhance the effectiveness of investments and the slum upgrading policy. As a method, we have started with the construction of an analysis grid based on literature review, defining parameters and categories of urban design projects in *favelas*, such as Connectivity, Sociability Open Spaces, Risk Elimination, Limits and Borders, among others. The process of building an analysis grid will provide feedback for selecting the urban design project case studies, which will subsequently provide feedback to the analysis grid that may then be revised based on the field observations. An assessment will also be made of concrete experiences of urban design projects in the *favelas* of Rio de Janeiro and São Paulo, their methodologies and the extent of the transformations, how these were achieved and how urban spatial design contributed to them. We believe that it is necessary to learn from built experiences, not only from best practices but looking at what went wrong, in order to achieve more efficient urban design methodologies in resilience. We will present case studies of the *favelas* in São Paulo that represent some categories of our research's analysis grid. As we will show, integrated urban design can deliver disaster risk reduction. Slum upgrading programs have produced good results in the treatment of river banks and flood-prone areas. In Cantinho do Céu and PAC-Alvarenga, public spaces have been implemented to prevent the reoccupation of the waterfront risk areas. But other examples show us how fragile the condition of public open space is. There are many factors that weaken the results. In Paraisópolis, the square of Grotinho is being reoccupied by a drug gang who expanded its businesses by subdividing and plotting the former risk area and the open space built by the State. We consider that integrated actions – encompassing social, urban design, infrastructure and environmental aspects, among others – are an effective solution in preventing risks. But urban spatial design in resilience still have the great challenge to find efficient mechanisms to solve the risk and to transform open areas into democratic public spaces in a permanent and sustainable way.

Keywords: urban design, *favela*, evaluation, disaster, risk.

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# Shouldn't all architecture be designed with empathy? A case of Design Probes for affordable housing design in Zanzibar

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Rapid urbanization and, as a result, fast growing slum areas in developing countries challenge the built environment to meet the needs of the inhabitants in a sustainable way. To build resilient sustainable communities the inhabitants need to be heard and be a part of the development process. This paper argues that affordable housing design, slum upgrading, and reconstruction require new forms of input from architects as well as contextually suitable and effective design methods for engaging inhabitants in the architectural design process. We suggest that architects can find support from human-centred design and specifically through Empathic Design methods. The study is done as participatory action research of an affordable housing design project in Zanzibar town, in Tanzania. The main contribution of this paper is to present the early stages of the design process with focus on one part of the human-centred design process where we used Design Probing, an Empathic Design method. Human-centred design of different kinds and levels is widely known and utilized in the design discipline to create products and services that match the needs and preferences of the users. Empathic Design is defined as a set of design techniques based on observation of the users in their normal, everyday routines that develops empathic understanding of users' unarticulated needs. Design Probing is a qualitative method of gathering inspirational data in interaction with users. A deep dive into the Zanzibar case introduces Design Probing to the architectural design process and clarifies the importance of empathy while designing in settings with contextual constraints. Design Probing can be a means to find the factors that leads a community towards resilience. Based on the analyses of the results of the design probing exercises we suggest that Design Probing as a method is useful for projects of this kind and that an empathic approach is a must.

Keywords: design probes; affordable housing; inhabitant engagement; empathic design; empathic architecture.

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## TRACK 4F

The role of heritage in reducing risks, building resilience, sustaining culture and enabling recovery and healing

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## Can creative placemaking be a tool for building community resilience?

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With our work rebuilding communities after natural disasters and strengthening them in preparation for future extreme weather, Enterprise Community Partners (ECP) has learned that for a community to be truly resilient, it must also focus on building human networks. Community-level interventions aimed at building social capital are relevant not only to emergency preparedness but also resilience to persistent stressors and shocks like violence and displacement. Research has found that the presence of strong social capital, both among people and among individuals and organizations, is a prerequisite for and a predictor of recovery and that social capital might be even more important to resilience than both the degree of infrastructure damage and the amount of aid received by an area. Building social cohesion and capital supports health resilience for our most underserved populations facing a myriad of day-to-day challenges in addition to the looming threat of climate change. Community development requires holistic investments and interconnections between physical and social systems. The goal of this project is to integrate culture and creativity into places and processes as a key strategy for building communities that are connected to opportunity, are resilient in the face of traumatic events, and that support residents' long-term health, wellbeing, and success. In 2017 ECP funded five culturally diverse and underrepresented communities from across the United States to participate in the Climate and Cultural Resilience (C&CR) Grant Program. This program leveraged creative placemaking, the integration of community participatory arts and culture in community development processes, as an intervention for improving community resilience by building climate infrastructure while strengthening social cohesion. In communities experiencing persistent challenges around economic insecurity, discrimination, or police brutality, climate is not always at the forefront. This program is demonstrating that if we connect mechanisms for understanding and uplifting culture to those that also reinforce climate issues, then we have a better opportunity to simultaneously positively impact climate and cultural resilience in communities. Qualitative analysis uncovered the themes associated with participating in the C&CR creative placemaking endeavors. We anticipate the results of the program will demonstrate that creative placemaking can promote more inclusive community development processes that increase equity and improve integration within community to build social cohesion. Incorporating creativity and cultural identity into community participatory planning processes shifts the research lens away from a deficit view of underrepresented communities, and instead focuses on and learns from the array of cultural knowledge possessed by socially marginalized groups that often go unacknowledged. In addressing resilience issues in underrepresented communities, culture and creativity coupled with community participatory processes must be integrated in public health, environmental, urban planning, and development research and programs, to build institutional knowledge and practice.

Keywords: culture, climate, resilience, equity, health.

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# Capacity of the temples and shrines for using as evacuation places and shelters on the tsunami hazard: the case study for the coastal area of Muroto, Kochi Prefecture in Japan

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Built heritage such as temples and shrines were utilized as the evacuation places and shelters when the Great East Japan Earthquake and Tsunami affected the coastal area of northeast Japan. The capacity of the designated public evacuation shelters, such as the gym of primary schools, was not enough against the huge number of evacuees. So, many of evacuees had stayed on their community's temple or shrines for their temporary living for several months after the damages of their town and home. From this lesson, the Japanese central government and local government have tried to designate the temples and shrines as the official evacuation place and shelter, after the Great East Japan Earthquake and Tsunami. This research focuses the capacity of the temples and shrines for being used as evacuation places and shelters. Firstly, we suggested the investigation form by collecting the research data of the cases of the temples and shrines that were utilized as evacuation places after the Great East Japan Earthquake and Tsunami. And we conducted a case study on the one of the hugest possible damaged area by the next tsunami (Nankai Trough Earthquake) in Muroto, Kochi prefecture in middle-west Japan. We evaluated 25 temples and shrines by the investigation form, that resulted from the previous research data. All 25 temples and shrines have the outdoor spaces for possible use as temporary evacuation and emergency staying. There are 12 temples and shrines that were allowed their indoor spaces to be utilized as the evacuation shelter. Through the interview research, we investigated the stocks of foods, water, beddings and facilities on the 10 temples and shrines, and the community activities which would help to make cooperation between these heritage buildings and the local community. We found that there is the areal association among the 7 temples, so this would be helpful to associate the emergency response team to support among these temples. And we could evaluate the potentiality of access routes for the safe evacuation to the built heritage and the management system by the result of the investigation for the community activities and indoor space of built heritage.

**Keywords:** tsunami; local culture heritage site; resilient built heritage; Nankai Trough Earthquake; evacuation planning.

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## Fighting urbamnesia

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Loss of identity and culture in demolished urban settings is often disregarded. I have defined this effect, urbamnesia, as “a city’s cultural oblivion and identity loss in a post-traumatic situation”. It results in the absence of human habits and singularity within a space; the loss of any notion of “place” (lieu) or “belonging”. I have developed the notion of urbamnesia over the past five years during my studies and personal work. I have documented urban environments related to disasters as well as met with various actors involved in the recovery process and anthropological approach to it. It is critical to have a reflection on the integration of cultural heritage and urban identity within the framework of disaster resiliency, which is in accordance with the Sendai Frameworks – Priority 4 – “Build Back Better”. Indeed, through a unique system of conditions, the integration of cultural and urban elements helps shape micro-urbanization, at a macro-scale. The objective is to understand how cultural roots weave together frameworks of resilience in specific geographies while identifying strategies to help re-develop their own identity and uniqueness through alternative designs, shared-memories, heritage and savoir-faire. Variables such as smell, sounds, colors, lights, interactions, informal business and vernacular architecture, cannot be standardized. It is these attributes that are threatened by the urbamnesia. To ensure cultural resilience, their survival should be secured. Because of urbamnesia, the new urban identity is often associated with the destructive event that occurred; it is the case in Hiroshima, Chernobyl or Fukushima. A framework of methodology can be drawn to prevent and understand these symptoms. First, recovered and recovering areas should be documented in-situ. Second, populations need to be included in the preparedness process and discussions. Third, spatial, economic and social parameters of the afflicted areas need to be surfaced, to help revitalize the pre-existing urban identity. Findings show that to avoid this syndrome, architects should work collaboratively with concerned communities and should start rebuilding within a permanent logic. By being sensitive to how a collection of singular, local behaviors shape the physical space, new settlements will be better adapted to receive displaced populations. In addition, these new “towns” should be as connected as possible to the demolished urban spaces. This way, affected communities can maintain their habits, the neighborhood’s relationships, commutes and feelings of belonging to comply with the United Nation’s Sustainable Development Goals of making “cities and human settlements inclusive, safe, resilient and sustainable”. Today’s context expresses a need for culturally tailored architecture in response to devastated urban areas. Destruction reveals how much the mixture of individuals shapes the cultural identity of a physical space. In an emergency, kilometers of refugee camps are built in a hurry, without thinking about human behavior. This in-between period, between disaster and reconstruction, is crucial to prevent urbamnesia. Designers should avoid repetitive geometries to leave some freedom for appropriation, overlaps, proximity and mix, where populations spontaneously gather. Communities need to be able to project themselves to quickly rebuild social interactions and urban attributes. This way, we will create better responsive urban spaces and architecture.

Keywords: urbamnesia; cultural resilience; urban identity; community attributes; belonging.

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## Back to the future: potentials of cultural heritage for urban resilience

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Many cities around the globe (still) comprise of historic fabric, particularly in the urban core areas. Very often intangible values, such as beliefs, events, habits or rituals are intrinsically linked with it. Such heritage constitutes a crucial source of identity for present urban inhabitants, which is not always reflected in urban planning or conservation realities although tangible and intangible heritage forms part of people's imaginings and has a high potential to contribute to more resilient urban futures. The presentation is based on own empirical studies in Kathmandu in Nepal, a city that still comprises of historic fabric and distinct cultural expressions. Urban heritage, habits and beliefs are still of importance to the population. However, the city is prone to rapid change, among others induced by natural hazards, rapid urbanization and densification as well as improvable planning. The high level of mainly informal urbanization in the almost built-up Kathmandu Valley has led to severe environmental problems and unplanned urban development including ongoing losses of traditional urban patterns. In the past decades, much of the traditional community activities got lost, urban heritage beyond state-owned properties is hardly protected, resulting in ongoing losses and alteration of historic buildings and ensembles. One example would be the traditional water spouts maintained by local communities during religious ceremonies that served as the main source of water supply for centuries and open spaces that can potentially serve as shelter places during and after disasters. As a consequence, the livelihoods of the 2.5 million inhabitants in the almost entirely built-up Kathmandu Valley are increasingly at risk, as seen in the aftermath of the 2015 earthquakes that caused widespread damage in the urban area. Among others, a large share of the urban heritage got lost or was severely damaged. The presentation is based on a combination of an extensive literature research, interviews and own surveys as well as mappings as primary data sources. Rooted in concepts of collective memory and genius loci, this presentation strives at highlighting the role that place attachment and traditional community-based practices can play for urban risk reduction. It gains additional significance given the devastating earthquakes and resulting debates on urban reconstruction. Although the Post Disaster Needs Assessment stated that local "communities have a strong and unique cultural heritage, which is an important part of their identity" and that "recovery interventions, particularly to do with housing and relocation should preserve rather than undermine these aspects of Nepal's proud cultural heritage" action on national scale mostly addressed single landmark buildings like palaces and temples, leaving ensembles or community heritage aside as they are hardly covered by policy. Particularly the latter one entail losses of habits, traditions and thus in the end traditional knowledge, sense of community and identity that are crucial components of urban resilience. Interestingly community and particularly youth-based initiatives now take the lead in lobbying for more sensitive reconstruction of heritage sites as important pieces of the urban past but at the same time as promises for the urban future.

Keywords: urban heritage; resilience; disaster risk reduction; place attachment; Kathmandu.

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## Protection of cultural heritage in case of forced mass migrations and its contribution to community rehabilitation during return process

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This study aims to examine the issue of protecting tangible and intangible cultural heritage whose existence is threatened by man-induced disasters such as war and armed conflicts, as well as the resulting forced migrations; and to discuss the role that cultural heritage as a driving power might play in returning home. Global Trends 2016 report published by United Nations High Commissioner for Refugees (UNHCR) indicates that the number of forced displacement due to security concerns reached 65.6 million people by the end of 2016. Particularly the dramatic rise between the years 2000-2013 is striking; number of migrants has grown from 150 million to 214 million in 13 years. Studies conducted on forced migration in terms of different parameters since the last quarter of 20<sup>th</sup> century by international organizations specialized in the subject show that the relationship between the migration and the cultural heritage as a constituent of migrant communities' collective memory is becoming an issue of bigger concern as the number of migrant increases. When looked at the treaties ratified by several countries, relationship between mass migration and cultural heritage is not defined; the Hyogo Framework for Action 2005-2015: Building the Resilience of Nations and Communities to Disasters (HFA), the Paris Declaration, On Heritage as a Driver of Development 2011, Sustainable Development Role of Local Communities Regulation 2012, and Sendai Framework for Disaster Risk Reduction (SFDRR) 2015 underlined that culture and heritage could be positive drivers for recovery of cities; and grounds should be laid for promoting the main role that the two play in human development. UNESCO's "Strategy for The Reinforcement of UNESCO's Action for the Protection of Culture and the Promotion of Cultural Pluralism in the Event of Armed Conflict" No 39/C, dated October 2017, approaches the issue of raising global awareness about the fact that cultural protection during armed conflicts would be devised in strengthening fast recovery; and emphasizes the solution under the title "The Key to Lasting Peace." At this point, it seems that emergency actions are required as a step forward from treaties concluded and recommendations issued on protection of tangible and intangible cultural heritage whose existence is threatened in consequence of forced mass migrations. Forced mass migration led by man-induced wars, armed conflicts, terrorist actions etc. increases the risk of tangible and intangible cultural heritage destruction; and prolonged conflict period postpones the returning of emigrated local communities to their homeland and consequently poses other risks. The fact that displaced communities by migration constitute the key point of issue; significance of sustainable returns in case of displacements by mass migrations; role of cultural heritage as a driving force in social and physical rehabilitation should be carefully considered when taking actions. That the sustainable development in the long run is made possible by the resources of country exposed to disaster; local structure production knowledge; specific user participation evidences the necessity of specific users' returning home. In PhD study dating back to 2013, taking case of Bosnia-Herzegovina, Kosovo, Lebanon, armed conflict-migration-return-cultural heritage protection relations, as well as similar destruction process started in Syria in March 2011 were investigated in respect thereof.

Keywords: cultural heritage, war- conflict, the return home and protection planning, collective memory, sustaining culture.

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## Heritage conservation and tourism: an integrated approach to post disaster healing and resilience building

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Shifting interest from vulnerability to resilience, specifically, community resilience, in Disaster Management is opening new perspectives: it recognizes the value of societal constructs such as the relationship between people and places, sense of community and identity, and how these collectively might aid in post-disaster recovery, emotional healing and building further resilience to future disaster events. Heritage conservation and tourism, two fields of study, have also made the connection with the concept of resilience and each has used it in relation to climate change and environmental hazards. Much needs to be done to address resilience jointly at sites where both heritage conservation and tourism visitation needs to be considered, not simply in the ecological context but also in terms of social and cultural resilience. Culture here includes tangible dimensions (physical, material) as well as intangible relationships to the site, symbolism, values and meanings the site holds for various stakeholders. This paper aims to advance understanding of the role of heritage conservation and tourism in community disaster resilience, specifically, their joint role in “cultural resilience” in community-based destinations that contain heritage sites. What is the role of heritage conservation and tourism at such sites in facilitating the capacity of a community to recover from disasters? To begin exploring this question, a two-stage study was undertaken: (1) A cross-disciplinary review of the use of resilience in disaster management, heritage conservation and tourism literature was conducted, and a preliminary framework of analytical terms and concepts was developed; (2) The framework was used to guide an exploratory study in Japan. Preliminary fieldwork was undertaken in 2013 at cultural heritage sites in 12 Japanese cities affected by natural and anthropogenic disasters throughout history. These are used as case examples and offer corroborating insights related to the literature review undertaken. The study demonstrates the need to go far and deep into culture and socio-ecological landscapes, addressing tangible and intangible relationships between the site, its history and cultural heritage, with visitation and processes by which society comes to terms with violence and tragedy. The study reveals that an integrated approach between heritage conservation and tourism is needed to understand the complex interactions between tangible and intangible aspects of the visited heritage sites, and its relationship to diverse groups including women. Based on the case examples examined, a preliminary framework for an integrated approach to heritage conservation and tourism is proposed. It is based on emergent study insights related to: (i) a community’s emotional links with place that occur in culturally related ways within socio-ecological systems, (ii) connecting people to the past in a way that facilitates social well-being, (iii) healing and gathering people in solidarity and peace through multi-layered approaches to heritage conservation and design for visitation.

Keywords: heritage conservation; heritage tourism; cultural resilience; Japan.

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## Social place of heritage: disaster risk mitigation plan in Asia

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Heritage sites and artifacts have survived various natural and man-made disasters. The destruction of local properties and places caused by the Great East Japan Earthquake, which occurred in 2011, is still fresh in our memories. However, several social places, such as temples, shrines and other heritage sites, survived this massive destruction and supported many earthquake and tsunami victims including tourists. Locals and tourists could stay together inside the shrines for a couple of days, since the latter provided safe environments. In this manner, heritage not only survives disasters but also ensures people's safety. According to the Sendai Framework, disasters have demonstrated that the recovery, rehabilitation, and reconstruction phase, which needs to be planned before the occurrence of a disaster, is a critical opportunity to "Build Back Better" by integrating disaster risk reduction into development measures and, thereby, making nations and communities resilient. Based on a collaboration between architects and anthropologists, we have carried out a comparative study of two earthquakes, the Wenchuan (China) and Gorkha (Nepal) earthquakes, and collected data on disaster experiences and disaster recovery processes. Subsequently, we discuss the potential of social places of living heritage that facilitate disaster preparedness in the Old Town of Lijiang (China) according to the following questions: which heritage sites are cultivated as social places? How can social places and activities be used in emergency situations? How can the function of social places be adapted to other World heritage sites? Through these analyses, this study proposes a disaster risk mitigation plan that involves social places and activities and integrates community-based disaster risk reduction measures for the world cultural heritage town in Bergama (Turkey). This paper aims to share the role of social places of living heritage in reducing risks, community resilience, and sustaining culture. It's shown a sharp contrast between the two earthquakes in terms of social places and social activities. Through these disaster experiences and disaster recovery process, this study revealed the potential of social places and activities for disaster risk reduction in the Old Town of Lijiang. It pointed out that social places such as small open spaces and pools are useful at the time of disasters. These places not only can cultivate their daily lives but also keep the town safe. Residents, commercial workers, and tourists should be integrated into and allowed to contribute to disaster risk reduction efforts. Finally, we propose to involve the social places in the proposed disaster risk mitigation plan for World heritage sites in Bergama. This will contribute to the enhancement of community resilience and promotion of sustainable heritage tourism by enabling the development of a disaster risk mitigation plan through collaborations with local communities. Even though the method of solutions is not identical, the role of heritage is expected to grow and reach the ultimate aim – sustainable life and heritage tourism development.

Keywords: World Heritage site, social places of living heritage, community resilience, disaster risk mitigation plan.

This study is a part of the outcomes of our research project titled "World Heritage and Disaster Risk Mitigation: For Sustainable Heritage Tourism in Asia."

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## TRACK 4G

Humanitarian architecture in practice: reducing risk and building resilience in incremental housing and post-disaster reconstruction

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## Architecture and war: a look at the city of Aleppo

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The theme Architecture and War has as its main scope the reflection about the role of architecture and its relation with the contexts of war, destruction and crisis. In fact, one of the great scourges of the twenty-first century is the explosion of conflicts and threats that arise from all parts, abruptly and unexpectedly. Daily the media report situations of war, attacks, and deaths, where armed confrontations have increasingly become a reality, making this a pertinent topic of urgent reflection. Faced with these contexts of instability we must find solutions to problems that are being created, believing that more and more the word unpredictability is part of the daily lives of many people who deal with it day by day. In the background, being the architecture in its structural base a system of ordering, rule, harmony, in the confrontation with the collapse, establish new logics of survival and spatiality towards this unpredictability. In this sense, understanding the assumptions underlying this restructuring are the main objectives of this research and intervention, based on the following points: to analyse the theme of destroyed cities and the role that architecture plays in its relation with memory of spaces and places destroyed; realize the true importance of emergency architecture in a scenario of destruction and collapse; propose a transitional shelter solution to respond to real needs by focusing on a specific example, as context of analysis, in the face of an immediate response situation in several times: short and medium term. So from the study of the city of Aleppo and its massive destruction since the start of the war in 2012, assumed today as the symbol of the massacred city where in addition to everything there are still hundreds of inhabitants who cohabit in this context of destruction, the main purpose of this analysis is to understand the forms of survival and the responses of architecture to new logics and ways of life as a strategy for urban reflection and reconstruction. Thus, this proposal has as its main focus emergency responses, and how architecture and the architect can be fundamental movers in the process of transition between the immediate, a situation of destruction and uncertainty, until a definitive moment, corresponding to the regeneration and recovery of the destroyed city. The main result of this approach is effectively, given the contexts of unpredictability and uncertainty, to see how one can through architecture find solutions that adapt to different events, needs and atmospheres. This being the major challenge of this study, to find, through the tragic example of Aleppo solutions that mould and adapt to any emergency of war, promoting new states of urbanity and safeguarding conditions of basic human habitation in extreme situations.

Keywords: war; destruction; Aleppo; human living; home.

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## Building strong foundations: a shelter terminology framework for humanitarian architecture

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The proliferation of and inconsistent use of shelter terminology in the shelter sector is a cause for significant conceptual confusion and has been identified as an obstacle to sector development. Experts have discussed this problem for decades, observing that accurate interpretation of shelter terms is only possible within a particular context or organisation. Shelter descriptors such as ‘emergency’, ‘temporary’, ‘transitional’, and ‘transportable’ are used interchangeably within shelter sector publications, with meanings intended to be implicitly assumed. As a result, there are a vast number of ways in which humanitarian shelter is described, with much contradiction, overlap, and duplication of meaning. Significantly, unclear terminology and lack of shared meanings contribute to the widely documented problem of inappropriate design and conceptualisation of shelter strategies. Given the growing interest in ‘humanitarian architecture’ as an emerging specialist area of architectural professional practice and architectural design education, ambiguous shelter terminology represents an obstacle for meaningful engagement from the architectural discipline with post-disaster recovery in communities, whether through practice, research, or education. Currently, the knowledge required to design appropriate shelter, or to conduct research into humanitarian architecture is hindered by the absence of a common systematic and comprehensive understanding of shelter-specific terms and activities. The goal of this research was to provide an overview of the array of terminology applied to humanitarian shelter in use in the sector and develop a Shelter Terminology Framework to facilitate the understanding and interpretation of shelter terms in context. Key documents from each Global Shelter Cluster (GSC) partner, including the three most recent GSC ‘Shelter Projects’ publications, and the ‘Sphere Humanitarian Charter’ were systematically reviewed using NVivo software to identify shelter terms. 347 shelter terms were identified and coded using a qualitative content analysis method. Terminology describing shelter strategies, stages, types and shelter artefacts encountered in the data accounted for eight main categories of shelter: Immediate, Intermediate, Permanent, Pre-Emptive, Non-Specific Shelter Terms, Shelter Items, Alternative Strategies, and Multi-Phase Shelter. Two to four sub-categories were identified within each of the eight categories, totalling 25 ways to define shelter strategies. The term or concept ‘Transitional Shelter’ was identified as a source of significant ambiguity and controversy, stemming from conflicting notions of the term referring to shelter as either a product or process. The research has illuminated a currently obscured area of knowledge. The value of the framework lies in its potential to reduce confusion surrounding shelter terminology. Significantly the Shelter Terminology Framework has the potential to equip architects and other specialist fields in the private sector, including professional practice, with a comprehensive overview of humanitarian shelter stages, types and approaches used in the shelter sector. Additionally, it can inform research, and educational courses emerging from academic institutions. It is anticipated that enabling a clear and consistent interpretation of usage of shelter terminology will have positive implications for partnering and collaboration to build humanitarian capacity, develop new approaches and foster innovation.

**Keywords:** shelter; terminology; Global Shelter Cluster; humanitarian architecture; architectural design education.

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## Improved vernacular flood resilient post-disaster housing reconstruction in Pakistan

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Following three years of extreme flooding in southern Pakistan between 2010 and 2013, and widespread destruction of housing, numerous post-disaster shelter reconstruction projects were implemented across the country. With limited resources available efforts were focused on learning from and improving vernacular architecture to enhance its flood resilience. However, a lack of guidance meant that the effectiveness of such design improvements was unknown. The key objectives for this research, which uses the reconstruction as a case study, were to provide rigour and evidence for future decision making about reconstruction and building back better. Researchers were commissioned by the Donor and the INGO working to coordinate the shelter cluster during the time of the flooding, to conduct an evidence based research study looking to holistically evaluate the different shelters. Academia, NGOs and independent reviewers collaborated to identify patterns, achievements and failures in the reconstruction. A robust methodology was developed to assess existing shelter against consistent criteria with input from the Pakistan shelter working group to ensure these criteria remain relevant. Buildability, maintenance, life cycle cost, material quality and thermal comfort were just some of the topics within the assessment criteria. Achievements included the increased use of improved vernacular architecture, namely the use of stabilised earth construction. Issues which were identified involved basic structural detailing missing; such as ring beams and lintels. Working with a University in Pakistan, the project incorporated physical testing of full scale wall panels subjected to simulated 2010 conditions. With the aim of testing to fill the guidance gap, and provide an evidence base for design decisions, different disaster risk reduction methods employed in the field by shelter agencies were explored. The relative performance, cost, and embodied carbon of each design decision was recorded. Key findings include that sacrificial mass and stabilised render covering an unstabilised earth wall - design principals used by many agencies - do not provide sufficient flood resilience; these panels failed just as quickly as panels which were simply earth alone, with the extra investment not resulting in better performance. Low carbon and low cost improved vernacular flood resilient shelters can be designed, providing the correct principals are followed; that stabilisation is applied throughout the wall, to the height where flooding is likely to occur. The research has informed a design decision guide (in lieu of building codes which are not currently appropriate for vernacular construction), aimed to provide practitioners with the tools to make informed choices about their designs. Shelter agencies using the guide will be able to demonstrate how design choices impact the performance of shelter against flooding and heavy rain, and what the cost and carbon implications of these choices are. Shelter agencies following this guide will be able to design flood resilient shelters which are low cost and low carbon, and avoid making ineffective DRR additions that offer little improvement.

Keywords: vernacular architecture; DRR; flooding; build back better; Pakistan.

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## Land readjustment for reconstruction in Taukhel, Nepal

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On Saturday, 25 April 2015, a 7.6 magnitude earthquake occurred in Gorkha district, approximately 76 km northwest of Kathmandu City, Nepal. In less than three months, 300 aftershocks with a magnitude higher than 4.0 on the Richter Scale struck the country. There were more than 9,000 estimated casualties and approximately 23,000 injuries. Thirty-one of the country's 75 districts were affected, with 14 severely affected. While the National Reconstruction mechanism has officially adopted the concept of "build back better" into their reconstruction framework, the existing mechanisms fall short in terms of allowing communities to access the support needed to secure their right to adequate shelter and minimize the impact of protracted or reoccurring displacement. While progress is being made in some areas, the significant delays in reconstruction are resulting in conditions of protracted displacement that may result in negative impacts on existing communities for years to come. Taukhel, an auxiliary settlement of Macchegaon in the Western part of the Kathmandu Valley, was the most heavily damaged of the three communities in Machhegaon. Of the 86 houses in the community only 26 remained standing, and four people died. Like in other Newari communities, most of the homes in Taukhel have been constructed with sun dried bricks and mud mortar on very narrow plots. Because of the narrow plots, it is extremely difficult if not impossible for the community to rebuild, not least because of the design guidelines laid out by the municipality. Thus, the community is advocating a different technique than many other places: they propose building back better by using land readjustment to improve the safety and quality of the built environment in their community. Land readjustment is a land assembly mechanism that has been traditionally used to enable entrepreneurial land redevelopment in rapidly urbanizing areas. As a land assembly mechanism, land readjustment projects seek to make possible urban infrastructure upgrades, increase housing supply, expand urban areas, and re-distribute land, among other objectives. In addition, LR projects often aim to be self-financed, which is made possible due to the increase in land value because of the readjustment project. While often used for development projects, land readjustment is a tool that has also been used in various post-disaster scenarios. This tool considers a holistic approach to urban redevelopment as it integrates urban economy, city planning, law, and governance capacity. In addition, it brings together practitioners of different expertise, including planners, architects, policy makers, sociologists, environmental engineers, among others, to develop a holistic project. This paper describes the process of land readjustment in Taukhel, Nepal, and its potential to improve resilience in post-disaster communities through architectural practice, urban design, and community engagement. In doing so, it hopes to not only raise awareness of reconstruction challenges in Nepal, but provide a model for new forms of humanitarian architecture and reconstruction planning.

Keywords: land readjustment, Nepal, earthquake, reconstruction.

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## Elderly residents risk perceptions: in-house sheltering preparation for Northern Thailand earthquakes

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The “Chiang-Rai earthquake (Mea-lao earthquake)” on 5 May 2014, also known as the “Northern Thailand earthquake”, was the strongest earthquake ever recorded occur in-land of Thailand, as reported by the National Disaster Warning Center. The earthquake caused damage to housing, infrastructure, schools and historical building; in the rural areas, the impacts included that more than 20% of senior-residents found it difficult to evacuate. This research focuses on the analyses of elderly residents’ evacuation and sheltering’s behaviour during and after the earthquake; as well as om risk perception toward building types that can help in the decision made to evacuate. This part of research provided the questionnaire to 80 households; focus in elderly group only. The research aims to analyze the damage by housing types and check resident’s perception in disaster risk. The result shown that residents also realize they live in the area prone to earthquake disaster. But when experiencing the earthquake shakes, they lacked the knowledge of how to secure themselves during evacuation and thus residents were hardly able to define the scale of earthquake, also they have lack knowledge in the safety of their own building structure. After the earthquake and related damage, residents in Tahor Community lacked money to repair their houses to be stronger for earthquake resistance. From research survey, about 64% of elderly residents decided they would not evacuate to the community shelter prepared by the local government because they worried about their own houses, and 30% wanted to have in-house-shelter and during the last earthquake in 2014, they experienced difficult times, living on the road-side self-made shelter for a week without electric and clean water. The study concludes that for elderly residents, it is difficult to evacuate from their place to local shelter and also residents think that the shelter provided now by the local government is still not suitable for elderly residents. Yet, if they stayed at their own house, residents also have stress toward aftershocks that could cause the collapse of their houses. So 50% of the participants decided to sleep on self-made shelter on the road-side, so we offered the design sample of “In-house shelter” and ask residents to evaluate the satisfaction score for future developments. This study concludes that in-house shelter design might be able to support the need of this elderly residents.

Keywords: community-based design; in-house shelter; earthquake; elderly residents; building resilience.

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## Upcoming temporary and memorial city

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Since World War II, the war has as battlefields our cities and the society is the major target. Day by day war is being one of the biggest atrocities against human life and also a crime against cities and architecture. This violence has a huge psychological impact in all these inhabitants forced to leave or fight. Though, they want to return to their country so it is essential to meditate about the future of cities and in those who want to homecoming as soon as their city is peaceful. Peace building and healing of society's injuries is not just a political responsibility. Urban planners and architects have an important role to play in this matter. Thus, the objective is to think further in post-disaster reconstruction considering new and temporary places of rapid response, to receive the inhabitants in their cities after conflict and allow them participate in the reconstruction of their own city as a way to instigate the sense of belonging and to reconnect the social and cultural ties. In this context, the main objective is to discuss the role of the architects in the reconstructions' processes and to reflect about the different ways of cities' regenerations through a proposal developed in the scope of the international competition "Syria: Post-war Housing". The proposal focuses on a temporary town for post-war Syria and turned out to be a criticism to the competition. The developed proposal does not aim at an early and possibly illogical configuration for post-war posterity in Syria, nor a set of dwellings for a certain unknown area and without urban fabric. The idea thus arises from a middle ground between architecture to reinvent the cities after they are destroyed and the emergency architecture of immediate action - a temporary city of shelter to those who return and who long to rebuild their country. Praising the remaining pillars, the analogy of pillar/family emerged and the concept of familiar resilience is enhanced by the metaphoric expand of the persistent pillars. The rubble would be used to build prefabricated modules that would be stacked according to the household, creating a house and a commercial place that through it reproduction generates an urban tissue in any region. In the end of the whole city reconstruction, the temporary city would become an urban space with new functions missing in the city or elected by the inhabitants, and a memorial of the city in parallel. This present idea performed as a criticism of the mentioned competition which illustrates the idea of non-deliberate approach when there are so many factors to consider in post-conflict reconstruction. In former times, rebuilding of conflict and divided cities were carried lightly and without reflecting upon the inner problems, as the example of Beirut. As a result, the approach of this proposal intends to criticise this light reflection in such complex matter with a recovery post-war suggestion, aiming a quick response, temporary and permanent urban solution, and an attempt of restoring bonds between the society and the city.

Keywords: post-disaster reconstruction; housing; temporary city; future city; memorial.

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# What role(s) do architects play in building resilience in post-disaster situations? Uncovering the heterogeneity of the post-disaster resilience architect

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A wide-ranging discussion already exists within the disaster scholarship and practice on the social, economic and cultural repercussions of reconstruction strategies, amongst which economic and social impoverishment, marginalization and disruption of social networks. Yet the various roles architects (should) play in addressing these repercussions have been limitedly discussed. The reality is that building professionals not only contribute to the construction of safer and more ‘resilient’ buildings in their role as designers of material artefacts, but also engage with various reconstruction agents (governmental authorities, NGOs, fund providers, community leaders, civic groups) to co-guide socially complex, multi-level, and highly intra-disciplinary rebuilding processes that address or reinforce socio-spatial ills. To fill the lacunae in the scientific discourse, this paper investigates the multifaceted role of architects in fostering (or hindering) the resilience of disaster-affected houses and communities in and through post-disaster rebuilding and resettlement processes. The research sets out to uncover the recovery-resilience-architect nexus by bringing theories of disaster recovery and resilience, multi-level governance and political architecture in dialogue with each other. The heterogeneity of roles acquired by architects in post-disaster multi-governed recovery processes (social, political, physical) is empirically covered during fieldwork conducted by the first author in the Merapi area (Indonesia) between February and March 2018. During this two-month visit, a short study of three post-2010 volcano eruption recovery programs was conducted for primary data collection. The three programs were purposively selected to dig into the multifacetedness of architects in different rebuilding strategies (varied levels of engagement, authority, impact of the profession on the beneficiaries) in order to dig out the potential and limitations of the profession in ‘building’ post-disaster resilient houses and communities. During the study, the following research methods were mobilized: document survey, semi-structured interviews with key actors (governmental officials, local architects, urban planners, local professors) and questionnaires distributed throughout the villages in which the three recovery programs were implemented. Our research reveals that a multitude of different roles – single or combined - are taken up by architects who participate in reconstruction initiatives. The extent to which the chosen roles contribute to resilience building and vulnerability reduction in the contexts of heterogeneous disaster affected communities, we argue, depends largely on (1) the governance structure of each reconstruction project and its openness in bolstering multi-level interactions, (2) the understanding, respect and incorporation by architects of the cultural, political and economic specificities of each intervention area, and (3) the institutional and programming rigidities which can only be addressed when architects become radically politicized and connected with larger socio-political movements.

Keywords: Merapi; building resilience; architect; reconstruction; post-disaster.

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## Resilient communities, incremental builders: housing recovery from the 2010 earthquake in Villa Verde, Constitución, Chile

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In the morning of February 27<sup>th</sup>, 2010 an earthquake hit the southern regions of Chile followed by a tsunami causing 524 fatalities and around 500,000 homes either severely damaged or destroyed. This was the worst national tragedy in the last 50 years. The city of Constitución was severely affected losing 61% of its urban fabric requiring an extensive process of reconstruction. The process of reconstruction in Constitución involved government and the private sector prioritising an incremental housing model. This model challenged the traditional top-down approach for housing supply and proposed a 'half-built' house that required the direct involvement of the residents to themselves construct the 'other-half' of their house. The internationally acclaimed Villa Verde project, developed by the architectural firm Elemental, resulted in the construction of 484 houses organized in rows and around courtyards. The settlement is located approximately 2.5 km from the city centre with connecting access roads. Residents initially received one half of the two-story house built in a structural frame allowing horizontal expansion to the limits of the frame. The field observations evidence that Villa Verde's residents have made significant inroads towards improving their own houses and that the incremental model used by the architects has merit. However, understanding the relationship between the household's efforts and community efforts are less explicit. This paper asks two main questions. Can the housing extensions be a valid indicator of recovery and resilience? Can individual attitudes to incremental housing models be extended to collective behaviours? The aim is to analyse the key elements that facilitate the individual and collective achievements of the ongoing development in Villa Verde. This study analyses the resident-driven process of progressive housing growth in Villa Verde achieved 46 months after the residents received their houses. The survey was conducted between July and August 2017 and documented the status of housing extensions observed in the settlement. Additional sources for this paper included government and NGOs' reports and online publications, and review of relevant literature. This research demonstrates that the organised heterogeneous community promoted collective involvement in local initiatives for communal facilities and regulates the fulfilment of habitability conditions set as part of the settlement design. Individually, residents have shown their commitment to actively improve their living conditions through the adaptation of their homes based on their specific needs and resources. It was observed that most residents have performed housing modifications although there are differences in the level of adaptations based on their various motivations. However, there are examples of individual changes that have challenged the community agreements in terms of area occupied and materials used. Therefore, it remains uncertain whether the individual enthusiasm, and the apparent lack of limits for housing improvement, might begin to challenge and influence additional forms of community development and produce conflicts within the community that, in turn, lead to the deterioration of the collective cohesion, image and identity.

Keywords: post disaster; incremental housing; Villa Verde; Chile; Elemental.

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## Managing Mount Sinabung evacuees with non-generic disaster management

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Mount Sinabung is an active volcano located at Karo Regency, North Sumatra in Indonesia. The activity of this volcano never recorded in the last 300 years which makes Indonesian Volcanology Center (PVMBG) classify as volcano type B. There are no Early Warning System (EWS) and volcano monitoring stations for this volcano until this volcano erupted. Mount Sinabung became active and suddenly erupted in August 2010 causing 15,691 people evacuate in 24 camps. Mount Sinabung still erupted until now and make this volcano still in emergency status. There are many evacuees lived for many years in the camp make them vulnerable in economics, social, and education. This research aims to identify the disaster management has been done responding Mount Sinabung eruption. This research uses qualitative research methods by studying and recording data from various sources of information as secondary data and interviewing informants as primary data. This research uses purposive sampling and continued with snowball sampling method. The data obtained then analyzed with deductive thinking. The result show that the Government of Indonesia has implemented Non-Generic Disaster Management to make evacuees become resilience by relocate evacuees in 3 stages. The first stage for 370 households in 2015, second stage for 1,683 households in 2016 and the third stage for 1,655 households in 2018. The relocation built permanent house, communal facilities such as church, mosque, jambur at new location about 43 Km from Sinabung Mountain. The government also provide agricultural land and initial capital for them to start their new life better. This policy proven as the best solution to make evacuees become resilient facing the eruption. Evacuees has started their new life, they started farming, socialize, and practice their ancestry ritual like guro-guro aron even Mount Sinabung still erupted until now. The relocation make evacuees become resilient so they can cope with their own resources. The policy of Government of Indonesia to relocate evacuees even the volcano still erupt is a Non-Generic Disaster Management because they relocate in emergency phase. In general disaster management cycle, relocate usually done after the emergency phase is over. The relocation proven to be an effective way to gain resilience on evacuees. When a disaster occurred is needed a policy to implement quick response to solve the problem of evacuees with the aim to making them become resilient.

Keywords: non-generic, disaster management, Sinabung, eruption.

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## Incremental shelter and homeowner post-disaster expansions and modifications

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More than 1.6 billion people currently live in inadequate informal settlements that are unsafe, overcrowded, and lack basic services (Murray 2015). Disasters confound this daily shelter crisis – driving millions of people to become homeless each year. Incremental housing approaches recognize the complexity of delivering safe post-disaster shelter at scale and champion individual choice, leveraging informal construction markets and end-user preferences. While we have strong theoretical support for incremental housing, we continue to lack empirical evidence as to the choices that households actually make and how incremental housing strategies unfold over time. This research seeks to answer the question of: What modifications and expansions do households make following initial humanitarian shelter assistance? This study draws from longitudinal research conducted by the authors over a four-year period in the Philippines following Typhoon Haiyan, tracking 32 post-disaster shelter projects implemented by 27 different organizations, including both non-governmental organizations and government agencies. Project cases were bounded at the barangay level and consisted of differing shelter assistance, including repair and retrofit, transitional shelter, core shelter, hosting support, rental subsidies, and resettlement. Starting 30 months after the disaster, 1,540 households were surveyed on expansions and modifications made to their shelter following initial shelter assistance. Responses were classified, at the project and household level, into the type of modifications made and level of investment. Our findings unpack how incremental shelter approaches manifest in practice, revealing differences across modalities of shelter assistance. At the time of data collection, 31% of households had made no modifications, 27% had made minor modifications, and 42% had made major modifications to their shelter. Comparisons across these groups provide insight as to underlying barriers and enabling factors that either prohibited modifications or fostered ongoing construction. In many cases, initial shelter was ill suited for modification and the integrity of shelter was compromised when expansions or modifications were made by households – the desire to expand vertically, not horizontally being one example. Security of land tenure was found to be vital for enabling improvements to shelter, suggesting that establishing formal land agreements may be more significant than attempts at improved shelter design. The results of this study reinforce that incremental housing should be considered as more than just an ‘approach’ to delivering post-disaster shelter – it is a cross-cutting characteristic of how households recover. Understanding what expansions and modifications are made by households can better inform shelter assistance provided by organizations and governments – notably ensuring that structural safety, affordable financing, and decent living conditions are incorporated into long-term recovery and development.

Keywords: humanitarian shelter, incremental, Philippines.

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## Radical pragmatism: the post-disaster reconstruction work of Taiwanese architect Hsieh Ying-Chun and Atelier-3

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In the past 18 years, architect Hsieh Ying-Chun and his team – Atelier-3 – have conducted more than 3,000 houses in the post-disaster areas in East Asia. Facing varied critical site contexts and socio-political conditions, Hsieh and his team applied the reinforced lightweight gauge steel frame for housing reconstruction with three fundamental principles: 1) single-line drawings for participatory design, 2) simplified joints for collaborative construction, and 3) open system for adopting and submitting to climatic and geographic condition. Based on the above three principles, this paper thematically reviews the architectural practices of Hsieh and his team with selected key projects. These examined projects closely present how they initiated, articulated, communicated and implemented their principles in different sites. The analyses conclude that ‘self-reliance’ can be seen as their fundamental philosophy encapsulated in their notions of sustainable construction, green building, cultural preservation and creation of local employment opportunities. Following their philosophical ideologies, Hsieh and his team have treated the survivors as the ‘producers’ of their own houses, instead of the ‘consumers’. Meanwhile, by designing and building the houses together, the survivors had a chance to re-build their communities, regain their socioeconomic status, and re-establish the intimacy between architectural production and everyone’s everyday life. As a critique of dominant trends of consumerism, elite professionalism and aestheticism seen in today’s architectural practices in general and post-disaster humanitarian projects particularly, Hsieh and his team’s work provides an insight into the society of East Asia and illuminates its challenges and opportunities.

Keywords: post-disaster reconstruction, East Asia, Hsieh Ying-Chun, reinforced lightweight gauge steel frame, participatory design.

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## The story of Viðlagasjóðshús (disaster-relief houses) in Iceland: resilience housing after the volcano eruption in the Vestmannaeyjar Island

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Climate change has led to a drastic increase in the number of natural disasters worldwide. This has led to exponential growth in the number of people who have been forced to flee their homes. Studies of the present situation project that about 500 million people will have fled their homes by the year 2050. The global community is facing a challenge of immense dimensions. More and more of the affected people live in relocations and transitional environments for ever longer periods. “Transitional shelter”, originally planned as a short-term remedy while working on a long-term solution, has unfortunately often become synonymous with poorly designed and constructed dwellings, that ultimately become permanent. Houses tell stories about the spirit and social circumstances of the era in which they were built, and about the technical knowledge, culture, and priorities at the time. The “Viðlagasjóðshús” (disaster relief houses) in Iceland tell the story about swift responses to unexpected circumstances and about the ability of people and houses to adapt. On January 23, 1973, a volcano on Westamnn Island, off the south coast of Iceland, suddenly erupted and the island’s roughly 5,000 inhabitants were rapidly evacuated to the mainland. At first, it was impossible to estimate the duration of the eruption and whether the inhabitants would be able to return home. Soon after the evacuation, actions were taken to build houses that could serve as a permanent housing solution, if needed. The Disaster Relief Fund organized the importation of prefabricated wooden houses from other Nordic countries. In total, 479 houses were built in 20 places around Iceland. These were simple houses that were common in the Nordic countries, but relatively unknown in Iceland at that time. Considerable work was invested in adapting the houses to the Icelandic climate and other conditions. Most Westamnn Islanders decided to return home after the eruption ended, the houses were left behind and sold on the open market. They have been inhabited by many families, each of whom have adapted them to meet their respective needs. A survey on the disaster relief houses was conducted in 2016 at Aalto University in Finland. It focused on the advantages and disadvantages of the houses, their qualities as homes and the adaptations that had been made to them. The findings from the survey and interviews with inhabitants demonstrate that the houses have passed the test of time and provided their residents with safety and shelter, both as emergency housing in the aftermath of the disaster and as permanent homes thereafter. They support previous findings on factors that are crucial when solving post-disaster housing problems: first, the importance of locally integrated solutions; second, that the layout design and technical structures allow the inhabitants to adjust the houses according to their needs; third, that the various local stakeholders are always involved in the decision making; and fourth, that long-term solutions are planned from the very beginning of the process.

Keywords: social-cultural sustainability, resilience, reconstruction, home.

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## Post-disaster architecture: the role of temporary housing

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Post-disaster scenarios have frequently caused considerable numbers of homeless due to the damaged and destroyed houses. During the housing reconstruction process, temporary housing solutions play a crucial role to restore some sense of normalcy in the life of the affected people. However, these solutions have been highly criticized for being inadequate, unsustainable and for drawing away important resources for the overall reconstruction program. Through literature review, case-studies and best-practices analyses, the paper firstly discusses the importance of temporary housing and then presents principles, concepts and architectural/project recommendations to support the development of temporary housing solutions. The aim of the paper is to provide for the improvement of such solutions discussing concepts as community participation and designing for people, use of local resources, flexibility, simple construction systems, exterior and neighborhood spaces planning, future use of units/resources, among others. While discussing these concepts, the paper also suggests how they can be considered beforehand during pre-disaster planning for temporary housing processes. These way, the paper contributes to build resilient communities supporting them to be better prepared to deal with the homeless problem in an emergency situation, also contributing for a sustainable and more efficient reconstruction period, particularly in the case of the re-housing process.

Keywords: temporary housing; architectural recommendations; pre-disaster planning.

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## The 8<sup>th</sup> ICBR Lisbon 2018 publication outputs and the contributions of the Special Session and the thematic track on Humanitarian Architecture and Incremental Housing: Special Issues and Elsevier books

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The presentation focuses on the announcement of a Special Issue of an indexed journal that will be based on a selection of papers presented in the Special Session on Humanitarian Architecture and Incremental Housing and in the associated track. The conceptual and thematic framework will be discussed with regard to the 8<sup>th</sup> ICBR's motto – Risk and Resilience in Practice: Vulnerabilities, Displaced People, Local Communities and Heritages –, and taking into consideration the pieces of research submitted in each track. Also will be addressed the possible gaps in the literature produced through the most prestigious journals of the area and how this Special Session could try to fill them. In this sense, considering other publication outputs of the 8<sup>th</sup> ICBR and the goal of addressing some of the timelier and pressing matters of academia, and the social and humanitarian sectors, a first analysis points to the need for launching a call for papers open to the ICBR audience and beyond, to ensure that the goals of this Special Issue are met. Furthermore, in similar terms but in this case looking at the titles and foreseen contents, as well as the expectable larger audience to be achieved, it discusses a possible call for papers for the planned Elsevier books, remarking the differences, in terms of subjects and approaches, of the four books.

Keywords: 8<sup>th</sup> ICBR 2018 publication outputs, Special Issues, book chapters, Elsevier books, call for papers.

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## TRACK 4H

Exploring new pathways to improved resilience decision-making

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## Exploring the influence of social networks in the adoption of safer construction practices in Nepal

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Natural disasters often result in having humanitarian and governmental organisations providing technical assistance in the reconstruction process. However, earlier research has shown that the provided technical assistance often does not result in the application of the technical guidelines in practice. One of the reasons is that in many affected communities the actors communicating these guidelines are not sufficiently trusted or embedded in the community to enable adoption of safer construction practices. Through the analysis of social networks in the field, this research aims to find alternative pathways that enable and enlarge adoption. Through field research, the established social networks are explored, with a focus on their role in the adoption of hazard-resilient construction techniques after a natural disaster. This research focuses on the identification of trusted actors in social networks at the community level in two affected districts in Nepal using social network analysis. In one of the district, extensive technical assistance has been provided by humanitarian actors, while the other has had little assistance from humanitarian actors. Data is collected through a large sample of questionnaires, key stakeholder interviews, focus groups, structural assessments, and ward data. Through triangulation of the data and an in-depth study of the social networks, more insight is gained. Results show that when limited technical assistance is provided, local actors are able to gain knowledge about earthquake resistant construction techniques and apply them. Overall, the networks have found to be strongly organised around the engineers, that have been appointed by the government for this disaster event to grant financial support in communities when households reconstruct with earthquake resistant techniques. Results show that humanitarian technical assistance has not resulted in a significantly higher adoption on the short term but did lead to the recognition of a larger variety of community based actors as knowledge sources. On the long term, it is expected that this enables knowledge to remain in the communities and increase community resilience. Therefore, dependency on these external engineers can be unfavourable for community resilience. Other identified key actors, especially construction professionals, are willing to learn and take over the provision of technical assistance from humanitarian and governmental organizations and would like to benefit from their role as a knowledge source. This study recommends to strengthen their role, as they are also the ones responsible for the final application. This research suggests that, enabling these actors as knowledge source could more effectively empower communities to build back better and lead to a higher adoption in future projects. However, the study has also found that almost all key actors need to have an insufficient understanding of how to apply the techniques for designs that differ from the government recommended design. Since the financial support for earthquake resistance is likely to end in the upcoming years, knowledge exchange is needed to enable the application of earthquake resistant construction principles for any design.

Keywords: social network analysis; knowledge adoption; post-disaster reconstruction; disaster risk reduction.

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## Enabling earthquake resilience: a multicriteria decision-making adaptive reuse framework

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The increasing awareness of risks posed by earthquake-prone buildings in New Zealand is likely to cause inflationary economic factors and town centre decay in many provincial towns because of the disproportionate amount of the building stock that are earthquake-prone. These towns are currently showing early signs of urban decay, and are likely to experience changes in the pattern of land occupation and gradual devaluation of existing building stock. A number of heritage buildings have been abandoned to decay due to the lack of a decision support tool to assess their adaptive reuse potential to meet new market demand, and their relative importance to the overall community regeneration and resilience objectives. This paper sought to develop a multicriteria decision analysis (MCDA) framework to prioritise and rank heritage buildings for adaptive reuse interventions. The framework developed in this study will have an immediate impact that enables local councils to quickly ‘sift’ through the existing building stock that are earthquake-prone, and have significant useful life and adaptive reuse potentials to be identified, and where the timing is appropriate, to flag these properties for possible seismic strengthening and reuse. This framework will help building owners and local councils to target their resources better, and make contributions that are more substantial to the district net worth.

Keywords: multicriteria decision analysis (MCDA); earthquake resilience; prioritisation framework; adaptive reuse.

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## Updating integrated watershed conceptual model for Citarum River Restoration Program

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Citarum River is the biggest river in West Java and the most strategic river for Indonesian development. It has three cascade reservoirs so that it could serve the most developed area in Indonesia such as Jakarta and West Java Province, not only water supply for irrigation, hydropower, aquaculture and fresh/drinking water but also flood control for its downstream area. However, there are still annual flood-prone areas and water-scarcity areas in its upper part such as Bandung City. Despite of its strategic position, Citarum River stand as one of the worse river in Indonesia. In the last two decades, under climate change and land-use change influences, its environmental degradation has deteriorated public health and livelihoods, especially for urban area around its flood prone area. Nowadays, it is shown that all the effort of structural flood risk reduction, such as river normalization and dikes development based on previous masterplan are useless. Many study of developing additional water supply system for any urban area in its catchment area, including Bandung and Jakarta City is not only financially/economically but also environmentally not feasible. That's why, it is believed that furthermore in-depth study of Citarum River which addressing the actual parameter of its problems based on appropriate approach is critical for social and economic development of Indonesia. This paper provides a comprehensive review to identify key parameters that previous study had been neglected so that they achieved a bias conclusion that had been used to recommend a program development which is proved as useless solution. Secondary data and site identification are performed to support the hydrology, hydraulic, social and environmental key parameters identification analysis. An open sources hydrology and hydraulic mathematical model were used to see the impact of neglected key parameters. Interviews with local people and stakeholder were performed to verify the predicted social and environmental key parameters. The identified social and environmental key parameters were used to develop hydrology and hydraulic model scenario. Based on current results, it is found that the structural solution could only be useful when it is implemented after social and environmental problem have been solved. It is also found that the social and environmental problem key parameters converge to human activity where ground water, solid waste (garbage), sedimentation, and pollution are its product that will drive the Citarum River performance. For a short and medium term, a non-structural and structural solution are proposed to control the last three of those key parameters based on which Citarum catchment area is divided into several watershed areas. Each of this watershed area has an autonomy control system of solid waste, sedimentation and pollution. An integrated watershed management conceptual model encountering the above key parameters is then proposed based on this preliminary result. Further study is still on going to see the performance of this model when it is applied in the upperpart of Citarum River. The performance of these pilot project will be used to improve the proposed model.

Keywords: Citarum River restoration, West Java, integrated watershed management, conceptual model.

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## Simplified strategies for a quantitative seismic vulnerability assessment of healthcare structures

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Hospitals are highly complex buildings, due to the presence of technological equipment and facilities, and critical scenarios can arise in case of natural events as earthquakes. In fact, these structures are characterized by safety issues that concern both the construction characteristics, the contained equipment as well as the performed activities and functions. Therefore, it is important to carry out integrated evaluations, considering both the aspects of safety and functionality, to identify the key elements that can support decision-makers in the definition of organization and management strategies. The present work is part of the ASSIST project, which is aimed at the development of tools for the assessment and monitoring of building structures for healthcare services, with the goal to reach a framing perspective and an overall strategic vision, useful to correctly define the financial investments over several years. In the complexity of the problem, one of the main elements to be considered for the evaluation and control of building structures is related to the seismic safety of buildings. This information is, in fact, a priority and it is essential to properly operate the choices of possible interventions to improve the safety level. Moreover, in building structures with economically important plant content, evaluation of seismic safety should always be made by considering the interaction of the response with the functionality of the plants and more generally with the other non-structural elements. In the present paper, two simplified methods for the seismic assessment of reinforced concrete buildings are developed in parallel by two different research units. Both methods evolve from a previous experience on school structures and they have now been modified to take into account the complexity of hospital facilities. The simplified strategies allow to assess the seismic capacity of buildings using very few data and through a quick analysis. This way, it is possible to obtain a ranking of buildings based on their seismic capacity. With this data, the decision-makers can distribute the nowadays often limited available resources to perform specific and more in-depth vulnerability analysis. The developed methods are applied to a few pilot case-studies, comparing the results with more detailed finite-element push-over analyses. Results highlight a good reliability of the methods. In all cases, they are conservative and capable to correctly define a priority order based on the seismic vulnerability of the buildings. The simplified analyses, applied in a homogeneous and coordinated way on all the buildings, allow a correct comparison. Together with data on other aspects of safety and functionality, this information is important to properly address the use of resources.

Keywords: hospitals; seismic resilience; safety verification; simplified method; building capacity.

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## An investigation into the impact of individual differences on immersive learning environment preparedness training

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Immersive learning environments, such as the Hydra/Minerva Suite, use sophisticated technology to recreate emergency situation scenarios in a controlled environment. Using video, audio and written communication, as well as live action role play, immersive learning environments allow participants to practice and develop their emergency management skills. Immersive-learning environments have been shown to enhance problem-solving and decision-making in high-pressure situations, as well as to improve self-confidence and team work. However, limited research has been undertaken to assess how individual differences impact on people's experiences of immersive learning environment training. For example, participants with certain personality traits, such as high levels of neuroticism, may show increased anxiety during training, which could impair engagement. Further, research suggests that people who have high levels of conscientiousness, or who are more open to new experiences, may have lower levels of anxiety. People's levels of self-efficacy may also be important, with those who have higher self-efficacy levels exhibiting higher levels of persistence, which in turn may lead to better performance when undertaking high pressure training. Finally, people's current mood state can be important with previous research suggesting those experiencing low mood may find immersive learning environment training more anxiety inducing compared to those in a more positive mood state. Therefore, the current study investigated whether personality traits, and current mood state, can impact on a participant's levels of arousal and anxiety during Hydra/Minerva training. Participants were recruited from an undergraduate Policing degree course and undertook training on a range of Hydra/Minerva emergency scenarios, such as responding to a firearms incident. Participants were asked to complete a personality questionnaire (neuroticism, conscientiousness, openness subscales of the IPIP Big-Five), a general self-efficacy scale and a measure of current mood status prior to training. In addition, participants self-reported levels of arousal and anxiety at the start, middle and end of training. The results indicated that trait levels of neuroticism and current mood status did impact on people's response to Hydra/Minerva training. People who reported low mood levels, and those with high trait neuroticism, experienced higher levels of anticipatory anxiety. These results indicate that trainees who are in a low mood state, or who are more neurotic are likely to need additional reassurance and support prior to undertaking Hydra/Minerva training. Reducing anticipatory anxiety in these individuals could enhance the performance and learning during the training. Conversely, those with high levels of self-efficiency, and those who were more open to new experiences showed higher levels of arousal, which indicates that these participants were more engaged with the training. Overall, the results show that individual differences can have an impact on people's experiences of immersive learning environment training and that trainers need to be aware of, and to be able to respond, to these differences.

Keywords: preparedness training; simulation training; decision-making; emergency management; Hydra.

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## Enablers for improving seismic resilience of vulnerable buildings: a myth or reality?

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The increasing frequency and scale of losses from recent earthquake disasters and previous studies have shown that some stakeholders' practices in the natural hazard mitigation sector could serve as impediment to property owners decisions to retrofit their buildings. This study focuses on examining how other stakeholders' practices involved in earthquake resilience can be used to improve the resilience of earthquake vulnerable buildings. A mixed method approach, comprising of Semi-structured interviews and a questionnaire are used in this study. The research findings from this study showed four key enablers essential for achieving seismic resilience in vulnerable regions area. These possible enablers include the annexation of seismic risk appraisal in valuation assessment, publicly available GIS Earthquake Hazard map of earthquake-prone buildings, improved accuracy in earthquake risk assessments and the use of a risk-based insurance premium system. These potential enablers suggest how the other stakeholders and policy regulators can work together to develop earthquake-resilient and sustainable urban communities.

**Keywords:** earthquake-prone buildings (EPBs), property market, seismic resilience, risk mitigation decisions, building owners.

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## Increasing resilience to increase value: from mere survival towards opportunities for future

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Resilience must be one of the active qualities in every construction. Considering resilience as passive, you are not considering it as an opportunity to increase building value. Resilience should be an “intrinsic capacity of the project to generate active value within the building system”. Rather than waiting for or adapting to problems, the design should foresee possible changes, through strategic choices which trigger new interactions amongst components, both tangible and intangible. Changing can be seen not only as the reaction to a harmful event but also as a physiological change due to changing needs and time passing. We assume that the significance of resilience does not depend so much on the individual objects, but rather on the relationship between parts that the project is able to create. These links must be directed towards specific binding requirements, which directly derive from the “design program”. This is true for every scale of the project, from cities to buildings. As an example of application, we show a construction system we have been studying in which these principles are essentially expressed. This contribution shows how increasing resilience is not a cost but an occasion to produce an economic value, a duration value, a performances value, etc.

Keywords: active resilience, added value, adaptability, active sensible resilience governance, project oriented resilience.

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# A conceptual integrative approach to monitoring, evaluation and validation of Climate Change Adaptation measures for urban resilience

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Climate change adaptation measures are increasingly implemented by cities to improve urban climate resilience. Linking resilience efforts to specific adaptation measures can be beneficial in urban planning contexts characterised by limited resources and provide solutions within the constraints of an existing system. However, the effect of adaptation measures on urban resilience is rarely assessed and a conceptual framework in order to develop in the right direction is needed. In this paper, we propose such a conceptual framework. For the theoretical basis, we link the resilience discourse with transformation studies, as well as with the pathway concept of the IPCC. Furthermore, we include social science concepts and critical theory in our considerations. With the aim of combining these approaches, we develop a model that places decision points and development paths at the centre of our considerations. Both climate change and social change are accelerating. Therefore, it is important to develop further concepts, tools and practices to adapt to these accelerated changes and to deal with risks, simultaneity and uncertainty in order to shape the future. We suggest that monitoring and evaluating adaptation measures in urban areas is a fundamental element of resilient urban development. Therefore, we develop a two stage monitoring and evaluation process and propose an inclusive ongoing validation to address the high uncertainty. Based on the suggested conceptual framework, applied research with local initiatives should be undertaken to develop an applicable and standardised toolbox for practitioners in urban planning.

Keywords: urban resilience; climate change; adaptation measures; evaluation; monitoring

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## Exploring system thinking as a pathway to improve the use of knowledge in building resilience to climate-related hazards

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Building resilience to climate-related hazards demands the bringing together of various sources of knowledge and the institutional aspects associated with these sources. Apart from researchers and decision makers, local communities have come to be accepted as having valuable knowledge as well. As such, approaches that advocate building resilience and neglect the learning process through which all key stakeholders interact and contribute at every stage of the process may fail. In Nigeria, there is little understanding of how stakeholders engage in building resilience to climate related hazards. In order to promote an approach that embracing stakeholder engagement in climate hazard resilience building, we explore current practices in two Nigerian cities – Makurdi and Calabar. Data was collected using a combination of approaches that include questionnaire survey, focus group discussions and stakeholders’ workshops. Workshop participants were selected from relevant stakeholder groups representing government, academia, local community, NGO/CSO/CBO, and professional organisations. A total of 330 business questionnaires and 3300 household questionnaires were collected. Alongside the survey, two focus group discussions were conducted to interface with community and business leaders. We found that communication and exchange of knowledge between stakeholders is far from optimal and knowledge tends to be utilised ineffectively. This was evident in dichotomy between problem identification and solution favoured by key stakeholders. Differences in stakeholders’ interest, perceptions, and knowledge differ not only in problem and solution identification, but also the scale of the system to be considered and how best to communicate resilience information. This underscores the fact that building resilience can sometimes be a complex task. Thus, merely bringing together stakeholders to share knowledge on problem definition and solution may in itself be inadequate. Therefore, we propose a system thinking based stakeholder learning to enhance resilience building for climate related hazard. Knowledge exchange should be targeted in a six step approach including 1) problem definition, 2) system definition, 3) system synthesis, 4) system analysis, 5) identifying plausible future and 6) communication. Such structuring of knowledge exchange among stakeholders has potential to enhance stakeholders’ knowledge, facilitate dialogue and communication, and helps ensure that resilience building is future oriented. However, to formalise this system thinking based resilience building will require its applicability to be tested based on further empirical research in diverse context.

Keywords: climate-related hazard, decision making, local knowledge, stakeholders, system thinking

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## Effects on perceptual indicators in the evaluation of disaster resilience: a revision of the Coastal Community Resilience Model in the Southeastern Pacific Coast of Chile

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Tsunamic events are a frequent hazard to coastal towns and various models have been developed to find out the physical, environmental, economic and social resilience indicators, among others, that affect community resilience. Despite this, resilience models that have incorporated the perceptual dimension for the evaluation of coastal resilience of human communities are missing. Indeed, there is little information regarding the specific perceptual indicators that allow cities to better cope and adapt to the impacts of tsunamis, and this information is scarce on developing countries such as Chile. The aim of this study is to revisit an existing resilience model for the coast of Chile (The CORE model) to explore the extent to which perceptual indicators influence the resilience capacity of this study area to tsunami hazards. We used Principal Components Analysis (PCA) because it provides information on how variables are grouped and contribute to explain resilience variation. The study was applied to fourteen coastal villages, distributed within four towns, three communes, and two regions of Chile. A total of 28 indicators were subjected to PCA in order to determine which subset of indicators affect resilience and specifically whether perceptual indicators affect resilience positively or otherwise. Twenty-one of these indicators address the physical, environmental, and social resilience aspects of the villages. The seven perceptual indicators were obtained from a preliminary correlational study with the following results; subjective knowledge (SK) was positively correlated with intention of evacuation (IE) while objective knowledge (OK) was negatively correlated with risk perception (RP); past evacuation experiences (PE) was found to be positively related to both risk perception and intention of evacuation; and evacuation place attachment (EPA) was negatively correlated to risk perception. The PCA results indicate that all indicators influence the resiliency of the villages, yet their relative influence differs. Particularly with respect to the perceptual indicators, these were found to have a high relevance to resilience. The OK and EPA contribute the most to PC1 (eigenvalue = 7.46, 26.6% of total variance), with only the special needs population (social indicator) and forest buffers (environmental indicator) indicators with higher loading values. On the other hand, the RP and PE indicators contribute the most to PC2 (eigenvalue = 5.86, 20.9% of total variance), with only social capital, population poverty (social indicators), food provision distance (environmental indicator), and population density (physical indicator) indicators with higher loading values. The influence of perceptual indicators was found to vary also with respect to the urban, rural and indigenous character of villages. Overall, the PCA has been a useful tool to identify indicator clusters that affect the resilience of the coast. Furthermore, the incorporation of perceptual indicators would be crucial in future resilience studies in zones under tsunami hazard in order to recognize the grouping of multi-dimensional indicators. Finally, our findings shed light on gaps in planning policies and opportunities or planning coastal resilient communities considering the perceptual dimension of resilience, particularly in the case of Chile and other developing countries.

Keywords: coastal tsunamis; Chilean coast; CORE model; principal components analysis; perceptual dimension.

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## A multi-sectoral assessment of drivers to build food security resilience to shocks in Niger

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Understanding new pathways and alternatives to build resilience and particularly those taking a systemic approach considering the intersection of social, economic and demographic variables deserve more attention. Such an approach could provide a more holistic view and more clear guidance on policy interventions with a potential impact on resilience building. We illustrated this potential by analyzing multiple drivers from various sectors on food security resilience (FSR) in Niger, one of the most under-deserved and underdeveloped countries worldwide, and one where droughts have become more frequent and severe. We took advantage of the LSMS-ISA data to attempt defining as flexibly as possible the concept of FSR and move forward with its measurement and the investigation of policy-actionable drivers taking a multi-sectoral approach. Food security was measured as reportedly self-assessed by household heads through Food Insecurity Experience Scale (FIES) collected by panel data in two waves from September to November 2014 (post-planting) and from January to March 2015 (post-harvest) and representative of Niger and 26 additional strata representing settings and agroecological zones. According to changes in food security status (food secure vs food insecure) from one wave to the next, we identify four potential trajectories, two of which are compatible with resilient trajectories of recovery and resistance to shock impacts. Two shock exposures were considered, rain deficits at onset of rainy season (May-June) and being affected by drought in the previous year to the time of interview. Weighted estimates of each trajectory were provided for the country and rural vs urban areas. Associations with socio-economic factors were explored using multinomial logistic regression models. Analyzed samples ranged from 626 households in the case of exposure to droughts, 1084 households affected by rain deficits, and up to 3108 households to describe weighted resilient trajectories. Our preliminary findings point to a severe lack of food security in general and in particular lack of FSR to shocks in the country and extremely low FSR in rural areas. A better road network, access to markets, improved rural-urban connectivity and increasing education level might be helpful in building up resilience. Farmers and female-headed households are particularly vulnerable groups and need special and effective protection policies to improve their FSR.

Keywords: Sahel, education, farming, gender, market.

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## Portuguese literacy about climate change: an online media coverage study

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Climate change is an increasing concern across the globe, and Portugal accompanies this trend, with greater attention to environmental issues. However, levels of public information and knowledge on these issues are low, with the Portuguese showing a tendency to focus on the impacts of the climate change rather than the associated processes. This study aims to address this gap in Portuguese scientific literature. Specifically, this study aims to analyse the Portuguese online media coverage on climate change, considering nine main variables: (1) title of online newspaper, (2) geographical focus, (3) involved actors, (4) type of knowledge, (5) hazardous processes, (6) temporal hazardous processes, (7) risk management actions for climate change, (8) adaptation measures for climate change, and (9) climate change sectorial impact. A defined research equation was computed in Google motor search, particularly in its news database. Additionally, the timeframe (January 2017 – March 2018) and the origin country (Portugal) of the news articles were defined. A total of 217 news were selected and analysed. *Diário de Notícias* (17.5%), *Público* (16.1%), *Observador* (11.5%) and *Expresso* (11%) were the online newspapers that more frequently covered relevant topics on climate change. It was verified that half of the news had a national scope (50.2%), focused on the present impacts (82.0%), mostly involving planners/managers (38.2%) or politicians (36.4%), with a major focus on drought (34.6%) and forest fires (10.6%). Regarding risk management, most of the news focused on impact reduction and mitigation (39.2%). The main adaptation measures tend to focus on the prevention of environmental degradation (31.8%). Portuguese newspapers tend to construct climate impacts as a passive process, the actors involved not being active in the resolution of the problem and still showing a significant scientific illiteracy. Media communication on climate change may play an important role for mitigating the overall public low knowledge on the matter.

Keywords: literacy; climate change; online coverage; newspapers; quantitative analysis.

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## ResilOrgSim: simulating organizational resilience

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Organizations shape societies' economic, administrative, regulatory, and political activities. Their resilience contributes to the overall community resilience. Understanding and measuring the factors that contribute to organizational resilience has been subject of different studies. Moreover, standard organizations including the International Standards Organization (ISO) have developed principles and standard attributes of resilient organizations in order to promote organizational resilience at an international level. Various tools have been developed that can be used to measure organizational resilience. This paper presents a new simulation tool (application) called ResilOrgSim that has been developed based on the ISO\_22316 (Organizational resilience – Principles and attributes). ResilOrgSim helps organizations to 1) self-assess their resilience status based on the standard criteria; 2) simulate potential impacts of various disruptions on organizational recovery prospects taking into account the resiliency status at the time of disruptions, and the nature of disruptions; 3) to measure the impacts that improvements in resilience factors can have on post-disaster or post-disruption recovery of the organization.

Keywords: resilience simulation; organizational resilience; business continuity, ISO\_22316.

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## BIM methodology applied to asset management

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The use of Building Information Modeling (BIM) methodology is rapidly growing in the Architecture, Engineering, Construction and Operation (AECO) sector. This methodology comprises a set of procedures that improve the various phases of the construction process, such as higher productivity due to instant sharing of information, better interdisciplinary cooperation, automation of workflows and optimization of deadlines, minimization of extra costs, reduction of project compatibility errors, etc. These processes are possible due to the clear and transparent information sharing characteristic (interoperability) among all the systems belonging to the Building Information Modeling (BIM) methodology. Building Information Modeling (BIM) is an innovative methodology that enables a new approach to information management in construction, based on the design of a virtual information model. With its development, there was a great growth in the AECO industry, due to the solution of several problems of the constructive industry and the increase of the productivity. The implementation of this methodology is already mandatory in the public works of several countries. The BIM model is constituted by elements, and each element is aggregated a set of information, such as price, shelf life, mode of manufacture, among others. In this way, it allows a significant reduction in the loss of information, when there is a transition of information among the various project stakeholders during the various stages of the life cycle. Nowadays asset management is a challenging and increasingly important area in modern society, as efficient management, maintenance and operation of assets (buildings, equipment, infrastructures) can bring numerous benefits to organizations that own them. The global developments and the economic growth have increased the need to know well an organization's assets, in order to better control them through a holistic analysis, prioritizing and evaluating the organization's fundamental objectives. The objective of this work is to implement to a case study (Laboratory Operative Unit for hydraulic tests) the BIM methodology in asset management. This unit will be modeled in BIM with the information and detail requirements for the implementation of an asset management system, based on ISO 55000 Standards. In the scope of the study will be analyzed the current state of asset management practices in the order to identify the position of organizations in relation to the requirements of the standards. Finally, the study intends to present a method that demonstrates the advantages of the BIM methodology applied to asset management.

Keywords: asset management; ISO 55000; facility management; COBie.

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## TRACK 4I

Resilient structures under extreme loading: design approaches,  
earthquake loading, blast and impact loading, protection and  
strengthening, risk and vulnerability analysis

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## Earthquake risk perception in Khokana, Nepal before and after the 2015 Gorkha Earthquake

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Whereas risk perception research started in the 1960s in the US and in Europe, there is still a scarcity of risk perception research in many countries in Asia, including Nepal. This study investigated the change in the earthquake risk perception of the residents of Ward 21 (Khokana Village) of Lalitpur Metropolitan City in Nepal after the 2015 Gorkha Earthquake. In a survey conducted in November 2016, 106 respondents (76 males, 29 females, 1 unclassified; mean age 48 (SD 16), age range 18-83) rated four risk perception items on a Likert scale of 1 to 5 for two periods, before and after the earthquake. Wilcoxon signed-rank test was used to compare the paired before-and-after data. The results show that after the 2015 Gorkha Earthquake there is a statistically significant change in the perceived likelihood of earthquake ( $Z=-6.617$ ,  $p<0.0005$ ) with effect size  $r=0.46$ ; in the perceived knowledge of disaster mitigation actions ( $Z=-6.970$ ,  $p<0.0005$ ),  $r=0.48$ ; in the anticipation of financial loss due to an earthquake ( $Z=-3.886$ ,  $p<0.0005$ ),  $r=0.27$ ; and in the dread or fear of earthquakes ( $Z=-8.092$ ,  $p<0.0005$ ),  $r=0.56$ . This study proves that actual experience of a disaster can significantly heighten risk perception. Three of the four effect sizes are large. In this study, we are also reporting the kinds of impacts residents anticipate if a strong earthquake will hit their village again: loss of property (82%), injuries (66%), loss of family members (58%), and loss of livelihood (25%). Majority of the residents plan to keep themselves safe from a future earthquake by leaving their house and staying in open spaces (88%), reflecting the low confidence of the residents on the durability and safety of their house. This study can contribute in filling in the gap in empirical risk perception research in Nepal. Next steps should include investigating whether higher risk perception eventually leads to more precautionary behavior, such as improving housing safety.

Keywords: urban resilience; disaster preparedness; precautionary behavior; housing safety.

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## Stereotomy-related studies considering the effect of limited angle of friction on minimum thickness values for semi-circular masonry arches

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Conceptual understanding of the behaviour of masonry structures is essential for the structural assessment of cultural heritage buildings. The theoretical studies of present paper can help to quickly evaluate the safety of existing structures with special emphasis on structures with unknown stereotomy. The Couplet-Heyman problem of determining the minimum required thickness necessary for the equilibrium of an arch is based on the definition of the thrust line. The thrust line that must be kept wholly within the structure depends on loading overall geometry and stereotomy (brick- or stone laying pattern). The classical approach of the literature is to assume certain stereotomy conditions (mostly radial) and derive the corresponding unique thrust line and minimum thickness value based on limit state analysis. Modification of this problem set up however quickly leads to an optimization problem: i.e. considering the stereotomy a-priori unknown, a range of minimum thickness values becomes available for the same loading and overall geometry conditions. While it is relatively straightforward, that this range of minimum thicknesses possesses an upper bound, this paper focuses on finding a lower bound – a global minimum. It is demonstrated that stereotomy-related constraints are essential for a well-posed constrained optimization problem. First, the necessary condition for a non-vanishing lower bound of minimum thickness values is derived analytically considering the assumptions of limit state analysis, namely infinite friction and a no-tension material model. The method is applied to the case of the semi-circular arch of constant thickness subject to self-weight, though it is applicable to other arch geometries as well. For a full analytical treatment of the problem, a simplified structural model is considered: the arch is represented by its centre line as a reference axis and its self-weight is assigned to this axis uniformly distributed according to arch length, regardless of stereotomy. The lower bound thickness to radius ratio ( $t/R$ ) is found to be  $t/R = 0.0819$ . A numerical method is introduced to demonstrate the existence of a valid stereotomy at this lower bound. The resulting stereotomy is found to have an unrealistic topology from an engineering point of view with sections almost parallel to the resultant around the middle hinge, conflicting with the Heymanian assumption about no-sliding. Therefore, the angle of friction ( $\delta$ ) – hence the admissible range of stereotomies – is further constrained in the updated model. It is concluded, that relaxing the no-sliding assumption significantly reduces the admissible range of minimum thickness values by resulting higher lower bound values for traditional building materials with a dry-friction coefficient lower than 1 (with  $t/R$  yielding 0.1044 for  $\delta=\pi/4$ ). The general relation of  $\delta$  (ranging from 0 to  $\pi/2$ ) and  $t/R$  is investigated: The resulting diagram clearly illustrates the role of friction in the stability and possible failure mode of arches. The presented methodology offers a simple tool for incorporating a limiting angle of friction into the framework of limit state analysis.

Keywords: masonry arch, thrust line, limit state analysis, angle of friction, stereotomy.

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## Implementation of BIM in the rehabilitation of a building of public interest

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The number of buildings that have been rehabilitated in recent years has increased, making this, one of the areas with the biggest investment by the public and private sector. In fact, one of the main purposes of building rehabilitation is to increase its life cycle, allowing a better adaptability, increasing quality standards, reducing the utilization of new materials and energy compared to the construction of a new building. Considering this, it is essential to develop norms and methodologies that will supervise and reduce the negative impact of the construction sector, allowing the rise of a new and more sustainable sector. Building Information Modelling (BIM) is one of the emerging methodologies that provide a new approach to the process of control and management of all the information created and developed in the design phase by the various specialities, as well as by all stakeholders during the life cycle of the constructions, through the creation of a digital model of the building. The adoption of the BIM methodology is associated with project planning, cost analysis of the construction or energy analyses, and project deliveries of the building and constructed structures, as a result, nowadays there is a greater demand to adapt these tools in the early stages of the life cycle of a building. In Portugal most of the existing buildings were built before 1990, prior to the first thermal regulations, which is why they tend to have a low energy performance. It is essential to think about thermal efficiency for sustainable development, optimizing energy use without compromising the quality of the interior environment through the use of constructive solutions and more efficient technologies, such as the introduction of thermal isolation and the replacement of glazing spans and window frames. The choice of materials in addition to the regulatory constraints should also take into account other factors related to the environmental impact, and the use of materials made from recycled or natural materials should be preferred, provided they are compatible with the economic requirements and goals of the project. The present work intends to approach the application of digital tools as well as their efficiency in the rehabilitation of a building with public interest, using a method supported in the methodology BIM. The different analyses concerning the energy performance of the building are presented by testing different constructive solutions and analysing each of them, by using a more sustainable approach regarding the consumption of natural resources regarding the interior environmental comfort and durability of the building, as a way of observing what is the most effective solution and the advantage of using BIM at an early stage of the project. The application of BIM in the rehabilitation of the building allows the combined integrated study of the diverse types of performance of the building. The main conclusions obtained shall be presented in context and future developments of the work.

Keywords: BIM; Sustainable rehabilitation; Buildings with public interest.

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## Structural health monitoring and Bayesian decision analysis for resilient masonry towers

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The combined effect of aging, material degradation, environmental factors, human actions and extreme events can alter the normal structural behaviour and lead to damage that may result in the loss of the functions provided by Architectural Heritage, i.e. cultural, social and economic. Even recently, several heritage structures have been severely damaged or destroyed after various natural hazards. In most cases, by their very nature, there have been diverse challenges and limitations to assess the structural capacity and identify the status of heritage structures after the interruptions. In this respect, the role of Structural Health Monitoring (SHM) is supporting the operators in decision-making regarding either regular maintenance or exceptional measures by providing a real-time diagnosis about the health state of the construction. This is even truer in the case of architectural heritage, when the principle of minimum intervention must be respected and the range of applicable techniques is limited according to the conservation standards. Among all the factors, resilience of heritage structures depends on structural robustness, loss in structural functions and rapidity to recover after disruption. In addition, these resilience attributes affect the capacities of heritage structure which are structural, knowledge based, financial and organizational capacities. Disturbances like natural hazard related events may reduce one or more capacities. A resilience failure occurs when one or more capacities are exhausted. Thence, an effective management of the cultural heritage structure requires an approach which is able to account for the risks related to all the possible capacity failures and to provide strategies that maximise its resilience. Therefore, by using knowledge which is acquired from SHM it is possible to make timely interventions to decrease the vulnerability of structure, to minimise the consequences from failures and to decrease the time required in order to restore the original performance which is directly related with the structural capacity. But how to determine the real benefit of a specific SHM technology and decide of its use? Or how can the decision makers choose the most suitable one among different tools for their specific case before implementation? The answer has been found in the mathematical tool of the Value of Information from Bayesian pre-posterior decision analysis. Eventually, in this paper, the reference situation is the choice between installing a vibration-based monitoring system, or not, on a historical masonry tower in light of a possible consultation in case of an exceptional event, an earthquake. Indeed, the monitoring system manifests its importance when the damage is present but not visible and therefore it may jeopardize the safety of the users. In this context, the importance of vibration-based SHM to increase the resilience of an historical tower has been quantified by using VoI.

Keywords: resilience, masonry towers, structural health monitoring, value of information, Bayesian decision analysis.

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## Natural-risk analysis of the built environment: understanding strengths and weaknesses of both quantitative and qualitative methodologies

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Natural disasters hit the environment where human communities live. The consequent losses include damages to physical elements and resources of that environment, injuries and fatalities. In order to prevent and reduce these losses, worldwide risk analyses are carried out on each region or territory prone to natural disasters. These analyses are classified either as quantitative or qualitative. Both kinds have strengths and weaknesses, which are strongly related to the geographical distribution of the hazard. Firstly, this study aims to investigate the correlation between the geographical distribution of the natural hazard and the results of the risk analyses carried out with different methods. For this purpose, a compared study of the results obtained through quantitative and qualitative risk assessments of a region to earthquake-induced soil liquefaction events is proposed. In particular, the quantitative risk assessment method applied in this study is based on the geographical distribution of hazard, vulnerability and exposure, while the qualitative method proposes the active involvement of the social components related to the analysed region. The comparison shows that hazards localized in small regions, such as soil liquefaction, highlight the strengths and weaknesses of the applied risk assessment methods, which is the second objective of this contribution. The study leads to few results, listed below, which show the complementarity of such risk analyses in case of extremely hazards. Firstly, the risk analyses based on the quantitative method takes into account the geographic distribution of hazard intensity and vulnerability degree clearly identifying the elements, to which a mitigation action should be applied. However, the comparison shows that the results obtained through this method can underestimate the effects of localized disasters on the community: the relations among its different actors cannot be easily taken into account in models centered on geographical distribution of the risk ingredients. Secondly, the results of risk analysis conducted with a qualitative method cannot be easily related to the hazard intensity and vulnerability degree because a homogeneous value of it has to be defined for the whole analyzed area. Still these results clearly show the damages sustained by the community and the progress of its recovery. The results presented and compared in this contribution were obtained through analyses carried out on a post-disaster data collected in a small European municipality recently affected by soil liquefaction events.

Keywords: risk analysis; soil liquefaction; localized hazard; qualitative method; quantitative method.

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