# Understanding Risk Europe

## Innovate for Resilience

Proceedings from the 2019 UR Europe Conference

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Sommati of Amatrice, Italy: Damage caused by the 2016 earthquake that hit central Italy.
Photo: © Ivano De Santis.

"We are vulnerable, the fact that we understand risk makes us less vulnerable, but at the same time we are at the edge of another event."

**Joaquin Toro,** Ignites Host.

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# Contents

# Abbreviations

| | |
|---|---|
| BCP | business continuity plan |
| CAT bond | catastrophe bond |
| DCP | Department of Civil Protection (Italy) |
| DMCSEE | Drought Management Centre for Southeastern Europe |
| DRM | disaster risk management |
| DSM | digital surface model |
| DTM | digital terrain model |
| ECMWF | European Centre for Medium-Range Weather Forecasts |
| ECP | Empowered Communities' Program |
| EFAS | European Flood Awareness System |
| EFFIS | European Forest Fire Information System |
| EU | European Union |
| EUMETNET | European National Meteorological Services Network |
| EUMETSAT | European Organization for the Exploitation of Meteorological Satellites |
| FD | Floods Directive |
| FRMP | flood risk management plan |
| GDP | gross domestic product |
| GFDRR | Global Facility for Disaster Reduction and Recovery |
| GIS | geographic information system |
| ha | hectare(s) |
| HR | high-resolution |
| ICT | information and communications technology |
| ISIMIP | Inter-Sectoral Impact Model Intercomparison Project |
| ITOIZ | Istanbul Tuzla Organized Industrial Zone |
| JICA | Japan International Cooperation Agency |
| NEN | Neighborhood Empowerment Network |
| NGO | nongovernmental organization |
| NMA | National Meteorological Administration (Romania) |
| NMHS | National Meteorological and Hydrological Service |
| RO-RISK | Disaster Risk Evaluation at National Level (Romania) |
| RSCCS | Code for Building Safety against Earthquakes (Portugal) |
| RSRS | Roadmap for Safer and Resilient Schools |
| SLICE | Short- and Long-Term Impacts of Climate Extremes |
| SGM | Semi-Global Matching |
| SMEs | small and medium enterprises |
| UNESCO | United Nations Educational, Scientific and Cultural Organization |
| UR | Understanding Risk |
| VHR | very high-resolution |

# Acknowledgments

This report highlights key knowledge and experience shared during the Understanding Risk Europe Conference, which took place in Bucharest, Romania, between November 27 and 29, 2019. Understanding Risk (UR) is a global community of 9,000-plus experts and practitioners from over 130 countries active in the creation, communication, and use of disaster risk knowledge to promote and build resilience across the globe.

It was established in 2009 by the Global Facility for Disaster Reduction and Recovery (GFDRR), housed at the World Bank.
The proceedings, event videos, information about sessions and speakers, and presentations are available at the event website: https://understandrisk.org/event/ur-europe/.

This conference brought together over 350 experts from governments, development institutions, academia, civil society organizations, and the private sector to address the shared burden of rising climate and disaster impacts across Europe, and explore how technology and innovation can help create more resilient societies. This report draws on the contributions of technical session leads, speakers, and special guests, as well as conference participants. We deeply appreciate their dedication and commitment to improve understanding of risk and of opportunities for innovation that can enhance the resilience of countries, cities, and communities across Europe.

We would like to extend sincere gratitude to the Government of Romania, the Department for Emergency Situations of the Ministry of Internal Affairs, the Romanian Agency for International Development Cooperation, and the GFDRR, which served as lead co-organizers of the conference, along with the World Bank Group. We would also like to thank the Directorate General for European Civil Protection and Humanitarian Aid Operations of the European Commission for its collaboration and participation in the event.

We are particularly grateful to our opening, closing, and keynote speakers: Dr. Raed Arafat, Secretary of State, Ministry of Internal Affairs; Tatiana Proskuryakova, World Bank Country Manager Romania and Hungary; Pablo Suarez, Associate Director for Research and Innovation at the Red Cross Red Crescent Climate Centre; Otilia Ciotau, World Bank Senior Portfolio Manager; and Mr. Cătălin Constantin Harnagea, Director of RoAid - Romanian Agency for International Development Cooperation. We would also like to thank Mr. Călin Alexandru, Director General of the General Directorate for Medical Emergency Management of the Department for Emergency Situations for delivering the closing remarks.

We are very thankful to the technical session leads and Ignite speakers for their extensive efforts in organizing respective sessions. In order of the sessions, these include Samantha Cook, Luiz de la Plaza Brigas, Hitoshi Baba, Carina Fonseca Ferreira, Radu Vacareanu, Alexandre Costa, Emil-Sever Georgescu, Carlos Sousa Oliveira, Mauro Dolce, Daniel Kull, Sari Lappi, Florian Pappenberger, Paolo Fiorucci, Gregor Gregoric, Gabriela Bancila, Mihaela Sima, George Manea, Alina Kasprovschi, Alexandra Călin, Daniel Homsey, Cosmin Buteica, Mathijs van Ledden, Darko Milutin, Raimund Mair, Thierry Davy, Nataša Milić, Janusz Zaleski, Clemens Neuhold, Sorin Rindasu, Zuzana Stanton-Geddes, Ömer Inan, Jörg Schleenbecker, Dragana Radić Jovanović, Yann Kerblat, Brian Walsh, Anne Zimmer, Jun Rentschler, Manuela Sofia Stănculescu, Mihaela Toader, António Sousa Gago, Fernando Ramirez Cortes, Alina Sava, Carli Bunding-Venter, Carlos Castro, George Dimarelos, Mihai Stirbulescu, Gaetano Vico, Vica Bogaerts, Andreas Uttenthaler, Max Ferguson, Zac Yang, Mihaela Harmanescu, Xavier Gerard, Tafadzwa Irvine Dube, Nora

Mirzoyan, Zeynap Gul Unal, Luca Ponticelli, Matei Sumbascu, Raluca Trifa, Cristina Stefan, Mark Gallivan, Rosmarie DeWit, Bogdan Carlescu, Maryia Markhvida, Manya Deyanova, Giuseppe Margani, Kelvin Berryman, and Marina Neagu.

We kindly thank Dr. Raed Arafat, Secretary of State, Ministry of Internal Affairs, as well as the dedicated professionals within the Department for Emergency Situations: George Manea, Silviu Stoian, Lt. Col. Cristian Maciuca, Plt. Nicolae Dumitra, Theodor Mihai, and Cristian Barbulescu.

For their effort and support, we would also like to thank the core organizing team, led by Alanna Simpson and including Alexandra Călin, Zuzana Stanton-Geddes, Ioana-Alexandra Irimia, Oana Frant, Anne Mussotter, Alan Dinca, Brice Robert Bonjour, Simone Balog-Way, Yann Kerblat, Jon Mikel Walton, Miki Fernandez, Lucio Apolito, David Tucker, Andrei Zambor, Andreea Florescu, Mihai Preda, Ana Catauta, and Bogdan Topan. The team also greatly appreciates the support and guidance provided by David Sislen.

**Everyday, everybody has a responsibility in disaster risk management.**

Alanna Simpson, Senior Disaster Risk Management Specialist.

Tatiana Proskuryakova, World Bank Country Manager, Romania and Hungary.

# Foreword

**European countries are highly exposed to the impacts of natural hazards.** Between 1980 and 2017, natural hazards, including devastating wildfires, earthquakes, and floods, cost European Union Member States over €511 billion (EEA 2019), most of which was not insured, and caused more than 91,000 casualties. A recent tragic reminder of the risk at hand includes the 6.4 magnitude earthquake that hit Albania on November 26, 2019. Climate change, aging infrastructure and buildings, and natural hazards will only continue to exacerbate existing risks and the vulnerabilities of our countries. Sustainable and inclusive growth will be very difficult to ensure unless we step up our efforts immediately to better identify and prepare for upcoming disasters.

**Romania, the host country of this conference, is particularly vulnerable to disasters.** Over the last century, Romania has experienced 13 major earthquakes, which claimed the lives of over 2,600 people and affected more than 400,000 others. In 1977, more than 35,000 families were left homeless in a catastrophic earthquake that caused over €1.8 billion in losses in 55 seconds. Today, Bucharest is still distinguished by the highest seismic risk among all EU capital cities and is one of the 10 most vulnerable cities in the world. Romania also suffers the most flood events in the EU (EEA 2019) and ranks third for fastest-warming temperatures among the European Union's 58 largest cities (Europe One Degree Warmer, n.d.)—a sobering reality given Europe's recent rash of deadly heat waves.

**The World Bank is helping Romania to address this challenge.** We provide $600 million in investments and contingent funding to help Romania accelerate investments and undertake policy reforms in disaster risk management. More specifically, in the case of an imminent threat or in the aftermath of a disaster, Romania

will benefit from a $493 million emergency fund available through a World Bank financial instrument called a Catastrophe Deferred Drawdown Option (World Bank 2018b). We are also supporting the modernization of emergency infrastructure across the country by ensuring that more than 3,000 first responders can rely on safer and resilient response facilities at any time (GFDRR 2019). Furthermore, we are working with the Romanian government to develop a new national multi-hazard risk assessment (Ro-Risk) to inform risk reduction investments across ministries and help decision makers better understand the economic and financial impacts of disasters. In Bucharest, we are working with the General City Hall to identify sustainable and accelerated methods to improve the performance of the city's Seismic Risk Reduction Program (World Bank 2019).

**Beyond Romania, the World Bank collaborates with many countries on this important topic.** In **Bulgaria**, we are providing advisory services to the government to support its Flood Risk Management Plans by defining risk areas and identifying measures in line with the EU Floods Directive (World Bank 2018c). In **Greece**, Thessaloniki citizens teamed up with the local government and the Global Facility for Disaster Reduction and Recovery (GFDRR) to crowdsource safer routes to and from schools, harnessing open data principles to better inform the public about natural hazards (World Bank 2018a). In Poland, we have mobilized funds for the Odra-Vistula Flood Management Project, which aims to enhance flood protection infrastructure and related measures that will protect 5 million people from the harmful effects of floods (World Bank 2015).

**Technology and innovation in the field can help tremendously in making societies more resilient.** To allow innovation to improve disaster risk management, a starting point is improving access to data. For example, geospatial data collection and analytics can be leveraged to improve our understanding of the built environment before and after disasters. In addition to technical sessions, this conference also houses an information technology (IT) corner composed of five important Romanian initiatives on behalf of Code 4Romania, CivicNet, CitizenNext, Trencadis, and Whitecell Technologies.

**Disaster resilience is a cross-sectoral issue that requires the collaboration of many actors.** We are thankful to all our partners, experts, and representative of government, academia, civil society, and the private sector for sharing their knowledge and experience in understanding disaster risk to guide policies and investments for more resilient societies.

**Tatiana Proskuryakova**
World Bank Country Manager, Romania and Hungary

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Dr. Raed Arafat, Secretary of State, Head of the Department for Emergency Situations, Ministry of Internal Affairs, Romania.

## Opening remarks

# Emergency Preparedness in Romania

In his welcoming remarks, Dr. Raed Arafat, Secretary of State, Ministry of Internal Affairs and Chief of the Department for Emergency Situations, underlined the importance of the Understanding Risk Europe Conference, which brought together over 350 participants from 82 countries, united by a common resolve to build more resilient societies. He noted the range of disaster resilience stakeholders attending the conference, including civil protection authorities, civil society organizations, academia, volunteers, and technical specialists.

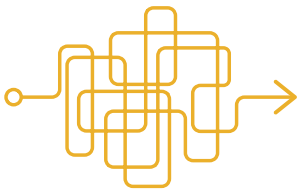
The Department for Emergency Situations under the Romanian Ministry of Internal Affairs is the operational center that coordinates at the national level all activities related to the prevention and management of emergency situations. The General Inspectorate for Emergency Situations, the General Inspectorate of Aviation, the ambulance services of the 41 counties and the City of Bucharest, the emergency rooms of the public hospitals, and the public Mountain Rescue services are all coordinated by the Department for Emergency Situations.

Dr. Arafat emphasized the importance of investing in preventive actions in emergency disaster management, and noted the many opportunities that governments have to improve their capacities. In the aftermath of disaster, it is critical that emergency coordination centers and rescue facilities are undamaged and fully operational, with staff uninjured, equipment undamaged, and energy, water, and communication systems functional. It is also critical that expected coverage of emergency operations—including fire and ambulance services, coordination centers, and police and gendarmerie units—is not compromised by physical damage to buildings and equipment.

Dr. Arafat highlighted the recent progress made by Romania in emergency response. The

country has allocated over €900 million in civil protection, medical emergency response, disaster response, and search and rescue activities, as well as in efforts to counter floods and other risks. Dr. Arafat shared the example of the collaboration between the Department for Emergency Situations and the World Bank, which includes retrofitting and upgrading of critical first-responder infrastructure. Supported through a series of investment projects (World Bank 2018, 2019a, 2019b), the Ministry of Internal Affairs will retrofit and upgrade priority critical infrastructure and strengthen its operational capacity in the coming years. This effort includes over 35 first responders' buildings used by some 1,700 rescue personnel, emergency and disaster management staff, volunteers, and administrative staff; over 35 police buildings used by almost 4,000 police personnel; and 27 gendarmerie facilities used by 4,248 Romanian gendarmerie personnel. In addition to enhancing Romania's capacity in emergency situations, this initiative can also foster the sharing of best practices within the Ministry of Internal Affairs and beyond.

In closing, Dr. Arafat cited the protection of citizens as a duty of all countries. He also underlined the importance of pursuing emergency preparedness through a whole-of-society approach where everybody has a role to play:



**"We need everyone. We need the people at the base of the community, up to the level of the president of the country. They are all part of the mechanism to deal with disasters and to reduce their impact."**

**Dr. Raed Arafat**
Secretary of State, Ministry of Internal Affairs

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"Sustainable development, good governance and disaster risk reduction are mutually supporting agendas. Natural disasters can affect the countries' entire economic, human and physical environment, as well as their long-term development plans."

Cătălin Harnagea, Director General, RoAid.

## Welcome remarks

The Romanian Agency for International Development Cooperation, or RoAid, has a mandate to implement projects and programs in the field of international development and humanitarian aid, as well as to facilitate the transfer of expertise from the Romanian public institutions and authorities to our partner countries.

As an institution, RoAid places great value in investing in disaster risk reduction and civil protection projects, and supports the efforts of partner countries to build capacity in this field.

It is well-known that sustainable development, good governance and disaster risk reduction are mutually supporting agendas. Natural disasters can affect the countries' entire economic, human and physical environment, as well as their long-term development plans.

Therefore, through our engagement, we seek to support our partners in achieving their development objectives as well as to reduce their vulnerability vis-à-vis natural disasters. In doing so, our collaboration with the Romanian Department for Emergency Situations is of critical importance.

In the context of the UN Agenda 2030, our joint projects with the Department for Emergency Situations are contributing to achieving the Sustainable Development Goals, particularly by strengthening resilience and adapting capacities to climate-related hazards and natural disasters.

As part of our excellent partnership with the Romanian Department for Emergency Situations, we also contributed to the Understanding Risk Europe Conference. RoAid has facilitated the participation of multiple delegations from outside Europe comprised by representatives of twenty-seven countries from all across Africa, the Caribbean and the Pacific regions. We are confident that their participation in this conference will contribute to the diversity of perspectives and richness of discussions.

# Ignites


**Joaquin Toro**
Senior Disaster Risk Management Specialist, World Bank (Host)

## Ignite 01

**Cristina Stefan**
Global Crisis Risk Platform, World Bank
Session 13

## Ignite 02

**Emil-Sever Georgescu**
The NIRD URBAN-INCERC
Session 2

## Ignite 03

**Daniel Kull**
World Bank
Session 3

## Ignite 04

**Manya Deyanova**
Mott MacDonald, Bulgaria
Session 14

## Ignite 05

**Jun Rentschler**
World Bank/GFDRR
Session 10

## Ignite 06

**Radu Vacareanu** Technical University of Civil Engineering of Bucharest, Romania
Session 8

## Ignite 07

**Carli Bunding-Venter**
World Bank
Session 9

## Ignite 08

**Cosmin Buteica**
World Bank
Session 5

## Ignite 09

**Luiz de la Plaza Brigas**
World Bank
Session 1

## Ignite 10

**Alina Kasprovschi**
Bucharest Community
Foundation, Bucharest, Romania
Session 4

## Ignite 11

**Yann Kerblat**
World Bank
Session 7

## Ignite 12

**Matei Sumbasacu**
Re: RiSe
Session 12

## Ignite 13

**Zuzana Stanton-Geddes**
World Bank
Session 6

**Joaquin Toro,** Ignites Host.

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# Assessing and addressing the fiscal and economic impacts of natural disasters: Recent experiences and innovations in country financial resilience

Session Contributors

**Samantha Cook,** World Bank

**Luiz de la Plaza Brigas,** World Bank

**Hitoshi Baba,** JICA

## Session Summary

Developing countries face an increasingly complex risk landscape. Interconnected hazards threaten to roll back development gains and undermine efforts to end extreme poverty and boost shared prosperity. Many countries are richer not because they have grown faster than poorer ones, but because they have had fewer episodes in which crises or conflicts shrank their economies. Climate change will further increase the intensity of weather extremes, exacerbating these impacts. This session showed the results of some countries, including Mexico, Colombia, Chile, Peru, the Philippines, and Jamaica, that have partnered with the World Bank in bringing to market sizable, innovative transactions in recent years. This session showcased some of this collaboration, sharing experience from a number of countries.

Ravenna, Italy - January 15, 2019: People and journalists following authorities of Ravenna to the Prefecture to discuss damages caused by the earthquake. Photo: © GoneWithTheWind | Dreamstime.com.

## Background

**Disaster shocks and other crises are a significant source of contingent liabilities and contingent revenue losses for governments.** Governments face significant contingent liabilities related to disasters, as they tend to shoulder a large share of the cost of response, recovery, and reconstruction in the aftermath of rapid-onset shocks or as a result of long-term stresses. Sources of government liabilities in the aftermath of disaster shocks include fiscal transfers to subnational governments, rehabilitation of (public and sometimes private) damaged assets, immediate relief and livelihood support, assistance to households, assistance to small enterprises, and stabilization of the private sector. Slow-onset disasters such as droughts and protracted shocks result not only in humanitarian impacts and loss to livelihoods but also in economic shocks, such as losses related to the disruption of agriculture value chains or energy price shocks due to reduced hydropower generation.

**In line with these facts, the World Bank is working on improving the quantification of budgetary impacts and impacts on debt sustainability to minimize the macro-fiscal impacts in advance of an event.** Analytics has guided the development and subsequent adoption of pre-arranged financial instruments to provide finance when it is needed most urgently, which is immediately after a disaster hits. Supporting the accessibility of such instruments, the World Bank has developed a flexible platform that allows its clients to access international markets for risk transfer schemes. Over the past years, a range of countries, including Mexico, Colombia, Chile, Peru, the Philippines, Jamaica, and others, have partnered with the World Bank to develop comprehensive financial packages to strengthen financial resilience against natural disasters. Providing end-to-end support for natural disaster risk insurance is one of the many ways that the World Bank helps member countries to build resilience against economic and natural disaster risk. The International Bank for Reconstruction and Development's AAA credit rating, market presence, and convening power allow the World Bank Treasury Financial Products team to develop innovative products that help clients maximize financing and mitigate risk.

## Case Studies

The World Bank's engagement on disaster risk management issues with client countries is predicated upon a strategic switch to an ex ante approach (i.e., preparedness for natural disasters before they occur) and away from an ex post approach (i.e., response to an event once it has materialized). Throughout the World Bank's engagement, emphasis is placed on knowledge transfer and technical assistance to client countries to reduce fiscal vulnerabilities to natural disasters by identifying, quantifying, preparing for, and responding to them in the most efficient manner. The World Bank Group aggregates within its different departments all the necessary subject matter expertise, from formulation to implementation of a comprehensive disaster risk financing strategy.

### Experience from Japan

The session benefited from a presentation by Dr. Hitoshi Baba of the Japan International Cooperation Agency (JICA), who shared the experience of Japan in developing and implementing preparedness solutions to complement financial solutions to promote faster recovery. The example of the East Nippon Highway Express served to demonstrate how having pre-arranged contracts in place can promote faster reconstruction. Information on establishment of contingency plans and business continuity plans was shared with participants, emphasizing the need to ensure that financial resilience and physical resilience are interlinked and complementary.

### Pacific Alliance

A recent example of sizable, innovative risk transfer transactions was the multicountry $1.4 billion catastrophe (CAT) bond executed in February 2018 for the Pacific Alliance (Colombia, Chile, Mexico, and Peru), through which the World Bank helped the four countries insure themselves against earthquake risk. Understanding the significant financial implications that earthquakes can have for a country's economy, the finance ministers of the four countries set the ambitious goal of working together to address this risk, increase countries' resilience to natural disasters, and expand their disaster financing options—all without increasing sovereign debt.

Once the Pacific Alliance countries decided to transfer catastrophe risk to the capital markets, they requested support from the World Bank, the leading provider of natural disaster risk insurance for emerging and developing countries. The World Bank delivered end-to-end support for the complex process, offering specialized technical assistance and facilitating the execution of capital market transactions.

The 2018 Pacific Alliance CAT bond was the first simultaneous issuance for four sovereign entities, as well as the largest earthquake CAT bond ever issued. The transaction exemplifies the World Bank's ability to help member countries access insurance through the capital markets and has established the World Bank as a leader in this role. The CAT bond attracted more than 45 investors globally, ranging from dedicated insurance-linked securities funds to pension funds to reinsurance companies, and it resulted in approximately $2.5 billion in investor orders. The high demand resulted in lower premium rates.

**The World Bank Group aggregates within its different departments all the necessary subject matter expertise, from formulation to implementation of a comprehensive disaster risk financing strategy.**

# Managing earthquake risk at a national scale: From strategic planning to on-the-ground actions

Session Contributors

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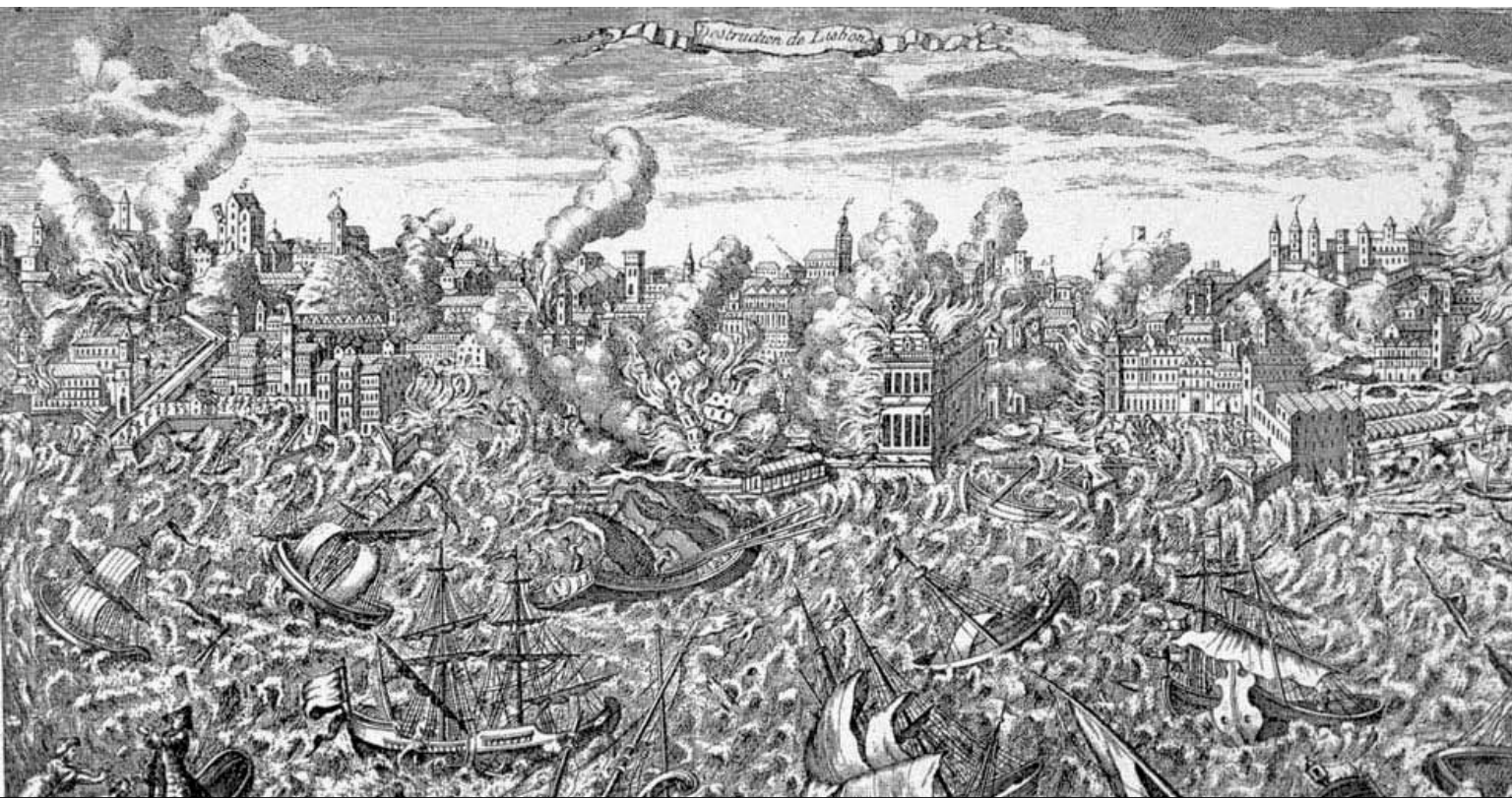
**Radu Vacareanu,** Technical University of Civil Engineering of Bucharest, Romania

**António Sousa Gago,** Instituto Superior Técnico, Universidade de Lisboa, Portugal

**Alexandre Costa,** NCREP-Consultoria em Reabilitação do Edificado e Património, Lda, Portugal

## Session Summary

How are countries managing earthquake risk at a national level? This session convened authorities and specialists from Romania, Italy, Portugal, to discuss how earthquake risk reduction actions are planned and what the main challenges and opportunities are for translating national programs into on-the-ground action at scale.




Lisbon, Portugal, during the great earthquake of 1 November 1755. This copper engraving, made that year, shows the city in ruins and in flames. Tsunamis rush upon the shore, destroying the wharfs. The engraving is also noteworthy in showing highly disturbed water in the harbor, which sank many ships.

## Background

Earthquake-prone countries around the world face the challenge of managing earthquake risk at a national scale. In the last decades, countries have progressively moved from a reactive approach to a proactive risk reduction approach aimed at minimizing the impact of future earthquakes on people, livelihoods, services, and growth.

## Case Studies

The morning of the earthquake, Amatrice, Italy. Photo: © Antonio Nardelli | Dreamstime.com.

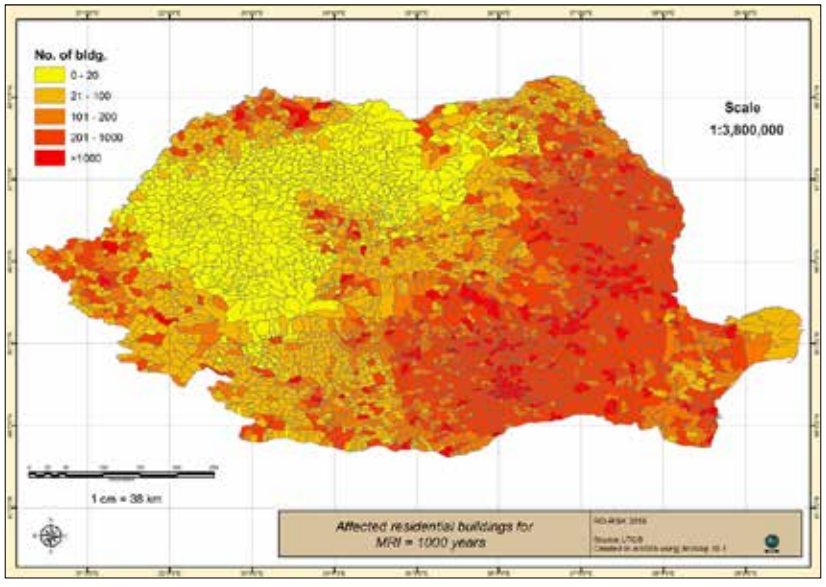
### Italy

Italy is among the European countries most affected by earthquakes. The 1980 Irpinia earthquake represented a turning point for disaster risk management in Italy with the restructuring of the disaster response system and the creation of the Department of Civil Protection (DCP) as a coordination body. The national civil protection system in Italy is regulated by the Civil Protection Code, which was issued in 2018 to supersede a number of separate laws established since 1982 to regulate civil protection activities in the country. The civil protection system is managed at central level by the Prime Minister's Office. Scientific institutions, civil society, and the private sector are important components of the civil protection system. Under the coordination of the DCP, scientific institutions are responsible for producing hazard, exposure, and vulnerability information that the DCP uses to estimate seismic risk, to strategically plan risk reduction programs, and to allocate funds to the regions to implement on-the-ground risk reduction intervention works. The national seismic risk reduction program in Italy includes structural intervention works to reduce the vulnerability of existing buildings, and nonstructural activities supporting risk-based prioritization of investments (including microzonation, risk assessment, and urban and emergency planning). Seismic microzonation studies are integrated into urban plans at municipality level with methods consistently defined at national level by the DCP. In addition, sectoral programs for seismic risk reduction in education, health, and other facilities are managed by the respective ministries. To reduce the vulnerability of private buildings, the government covers one-third of the costs. Private owners can also benefit from fiscal incentives if they decide to retrofit their properties to reduce seismic risk.

## Romania

Earthquake is the natural hazard most likely to cause fatalities and economic losses in Romania (Figure 1).[1] The capital city, Bucharest, is among the European cities with the highest seismic risk. Around 60 percent of the existing residential building stock in Bucharest was built prior to the 1977 Vrancea earthquake in accordance with low seismic design levels. It was only after the Vrancea earthquake that seismic design regulations in Romania started enforcing ductility requirements to improve the performance of constructions to earthquakes. As a result, thousands of existing buildings in Bucharest and across Romania are vulnerable to earthquakes and require retrofitting works to improve their performance. The government of Romania issued Government Ordinance 20/1994 on measures to reduce the seismic risk of existing buildings. The ordinance prioritizes the highest-risk buildings identified in the 1990s for public co-financing of seismic retrofitting works and details the seismic retrofitting program for multi-story residential buildings. The government is currently assessing the progress achieved by this program to date and preparing a new national seismic risk reduction strategy and investment plan to scale up results on the ground, with technical support from the World Bank.

Figure 1: Potentially damaged residential buildings in Romania under an earthquake scenario with a return period of 1,000 years.

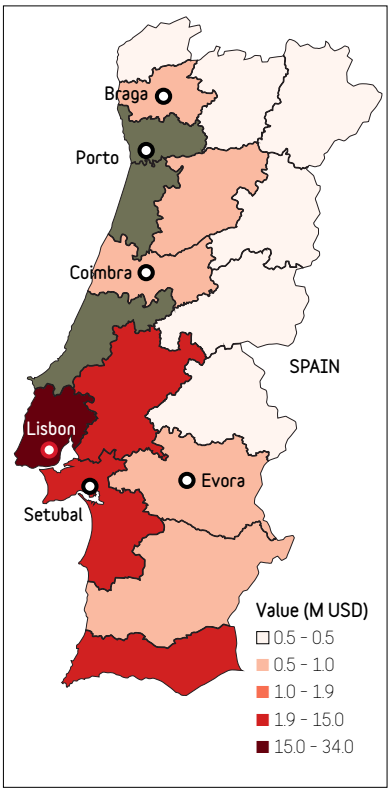



*Source:* RO-RISK Project.

## Portugal

Portugal is an earthquake-prone country that has been historically affected by damaging earthquakes (Figure 2). The 1755 Lisbon earthquake devastated Portugal's capital, and the oldest recorded large-scale recovery and reconstruction process in the world took place in its aftermath. Since 1958, when the first regulation for the safety of constructions against earthquakes (RSCCS) was put in place, building regulations for seismic design of new constructions have evolved in Portugal along with technical progress and best earthquake engineering practice of the time. Around 25 percent of existing buildings in Portugal were built before the first 1958 regulation was in place. The vast majority of existing buildings, around 70 percent, were built in accordance with the 1958 regulation and before the RSCCS was superseded in 1983 by the regulation for the safety of building structures and bridges (RSA). In 2014, a law was published to regulate urban rehabilitation in Portugal (law 53/2014, known as RERU); however, it did not specify

Figure 2: Annual average losses due to earthquakes in Portugal.




*Source:* Global Earthquake Model – Country risk profiles. GEM Foundation.

[1] General Inspectorate for Emergency Situations at https://www.igsu.ro/index.php?pagina=analiza_riscuri.

any requirements in terms of seismic performance. As a result, many existing houses were rehabilitated without considering the vulnerability of the buildings. This situation led to an increase in seismic risk due to a change in the use of the building or occupancy rate, as well as intervention works that increased the vulnerability of the buildings. A new government ordinance was published in 2019 (ordinance 302/2019) which changed the paradigm by making the seismic vulnerability assessment of an existing building mandatory under certain circumstances. This ordinance states that the rehabilitation of an existing building must include a seismic vulnerability assessment when the planned intervention will change the structural behavior of the building, more than 25 percent of the built-up area will be intervened, or the total cost the intervention works is above 25 percent of the replacement cost.

## Key Challenges

Key challenges include the following:

- Financial capacity of national and subnational governments to reduce vulnerability of existing public assets and co-finance intervention works in private residential buildings
- Lack of planning processes that can produce risk data and use the data systematically to inform the design and implementation of intervention programs as well as prioritization of investments and allocation of funds
- Lack of local technical capacity to design and implement seismic retrofitting works
- Poor communication between institutions and citizens and lack of public awareness on seismic risk and risk reduction solutions

## Key Solutions

The following solutions could address the identified challenges:

- Seismic risk management as an institutionalized process coordinated by an institution with strong convening power
- Integration of seismic retrofitting works into comprehensive renovation programs to increase the efficiency of the investments through upgrades on safety and energy efficiency of existing buildings
- Risk-based prioritization of investments aimed at maximizing the benefits in terms of risk reduction targets and people benefitted
- Development of systematic and tailored communication strategies and public awareness campaigns to progressively inform, build trust among, and promote buy-in by different stakeholders who play a key role in implementing actions on the ground.

## Recommendations and Conclusion

Reducing risk at national scale is a long-term effort, which requires strategic planning and leadership. While a national strategy normally defines the overall objectives, targets, and prioritization process to reduce risk, the implementation of specific operations is normally conducted at subnational level. Building technical capacity of local governments and mobilizing financing for implementation are therefore critical to achieve actual results on the ground.

# Leveraging regional systems to improve national forecasting and early warning of weather-related hazards

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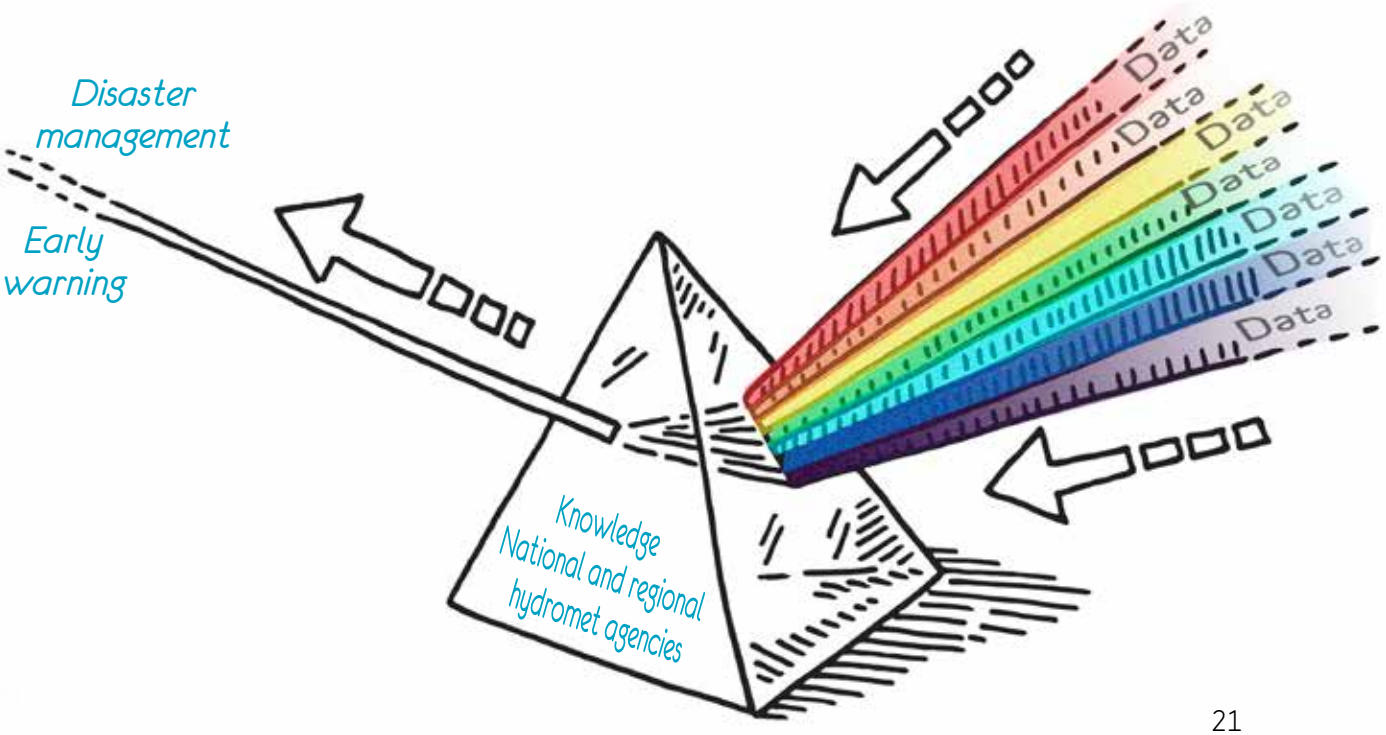
## Session Summary

Because Europe faces cross-border hazards, strong regional cooperation is essential to ensure the safety of European citizens. Regional monitoring, forecasting, and early warning systems for weather- and climate-related hazards have been developed to support national authorities in provision of timely and accurate hazard information and warnings for planning and executing needed actions at national level. It is essential that adequate resources are available at both regional and national level to continue the work of developing and improving the regional systems. Efforts are also needed to improve the utilization of the many regional systems available, for example by improving training and knowledge transfer, clarifying roles and responsibilities at national level (taking into account the different national and subregional circumstances), and considering new ways of developing the systems, such as implementing a multi-hazard approach.



## Background

The impact of natural disasters goes beyond national boundaries. Recognizing the transboundary nature of weather hazards, in particular storms, floods, droughts and wildfires, this session explored the regional monitoring and forecasting systems available in Europe. These systems exist to provide timely warning and sufficient technical data on impending hazards to inform national and regional level decision making on planning and executing domestic actions. European systems are considered global leaders in good practice, owing much of their success to the cooperation and established data-sharing mechanisms across borders, as well as their leveraging of modern ICT and remote sensing.

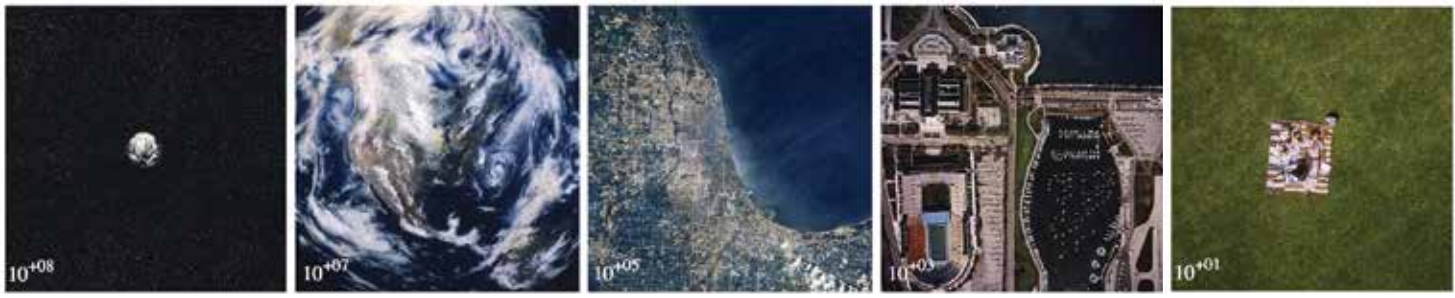
The session focused on delivering services, starting with how European monitoring and forecasting systems produce and ensure receipt of the information national authorities need to fulfil their institutional responsibilities. Session presenters explored how the Romanian forecasting and disaster management authorities leverage this information for national services to protect their country and its citizens. Methods for verification and quality control of regional and national warning service delivery were highlighted.

Europe is exposed to a variety of hydrometeorological and climate-related hazards, including heavy precipitation causing floods and landslides, droughts and wildfires, prolonged cold and heat waves, and severe thunderstorms and hailstorms. These hazards cause significant impacts to human lives and livelihoods and to functioning of key sectors, as well as damages to properties and infrastructure. It is expected that due to climate change, the frequency and severity of these hazards will increase in the future. This increase, combined with changes in land use patterns and increased human settlements in areas prone to disasters, could lead to increased risks in the coming years.

Disasters are often transboundary in nature: severe storms, floods, and wildfires frequently cross country borders, and droughts, heat waves, and cold waves affect areas much larger than individual countries. For example, during autumn 2019, severe storms and floods caused significant impacts in many parts of Europe, including the United Kingdom, Spain, France, Austria, Italy, and Greece; a number of people lost their lives, hundreds were evacuated from their homes, and material damages were significant. In summer 2019, Europe experienced a heat wave that set all-time high temperature records in many countries and contributed to the deaths of hundreds of people.

National Meteorological and Hydrological Services (NMHSs) play an important role in protection of the lives and livelihoods of people by providing early warnings for hydrometeorological and climate-related hazards. Their responsibility is to provide support to disaster risk management authorities and various socioeconomic sectors through provision of timely and accurate hydrometeorological and climate-related information and warnings. Utilization of regional systems and data sources greatly increases NMHSs' capabilities for providing forecasts and warnings for other national authorities and citizens.

"Powers of Ten" by Charles and Ray Eames, 1977.



# Case Studies

## European, subregional, and national services and programs

The European Centre for Medium-Range Weather Forecasts (ECMWF), European Organization for the Exploitation of Meteorological Satellites (EUMETSAT), European National Meteorological Services Network (EUMETNET), and European NMHSs cooperate closely to implement operational infrastructures and resources required to provide a comprehensive meteorological system for Europe, including ground and space-based observations, numerical weather prediction models, and forecasting services. ECMWF is an independent intergovernmental organization providing 24-7 operational service for production of global numerical weather predictions and other data for the center's Member States and Cooperating States as well as the broader community. ECMWF has one of the largest supercomputer facilities and meteorological data archives in the world and provides services for operational forecasting and research activities.

The ECMWF's role is to address the critical and most difficult research problems in global medium-range numerical weather prediction, which no one country could tackle on its own, aiming to avoid duplication of national capabilities and instead to extend and complement them.

In addition to the core organizations implementing the operational infrastructures, a number of initiatives and programs are implemented at European and subregional level to monitor and forecast specific weather- and climate-related hazards. A number of these were discussed during the session:

- The European Flood Awareness System (EFAS) under the EU Copernicus Program aims to support preparatory measures before major flood events strike, particularly in the large transnational river basins but also throughout Europe in general. EFAS provides complementary, added-value information—for example, in the form of probabilistic, medium-range flood forecasts, flash flood indicators, and impact forecasts for relevant national and regional authorities.
- The Copernicus Program also covers the European Forest Fire Information System (EFFIS), which monitors forest fire activity in near-real time in Europe, the Middle East, and North Africa and which supports wildfire management at national and regional scales. EFFIS supports the services in charge of protecting forests against fires in the EU countries and provides the European Commission services and the European Parliament with updated and reliable information on wildland fires in Europe.
- The Drought Management Centre for Southeastern Europe (DMCSEE) is hosted by the Slovenian Environment Agency with the mission to coordinate and facilitate the development, assessment, and application of drought risk management tools and policies in southeastern Europe, with the goal of improving drought preparedness and reducing drought impacts. DMCSEE coordinated the implementation of the DriDanube project, which developed a web-based interactive tool for near-real-time drought monitoring through different drought indices to enable more accurate and efficient drought monitoring and early warning for the entire Danube region as well as integration of risk and impact maps. DriDanube strategies and methodologies for drought impact and risk assessment were also developed.

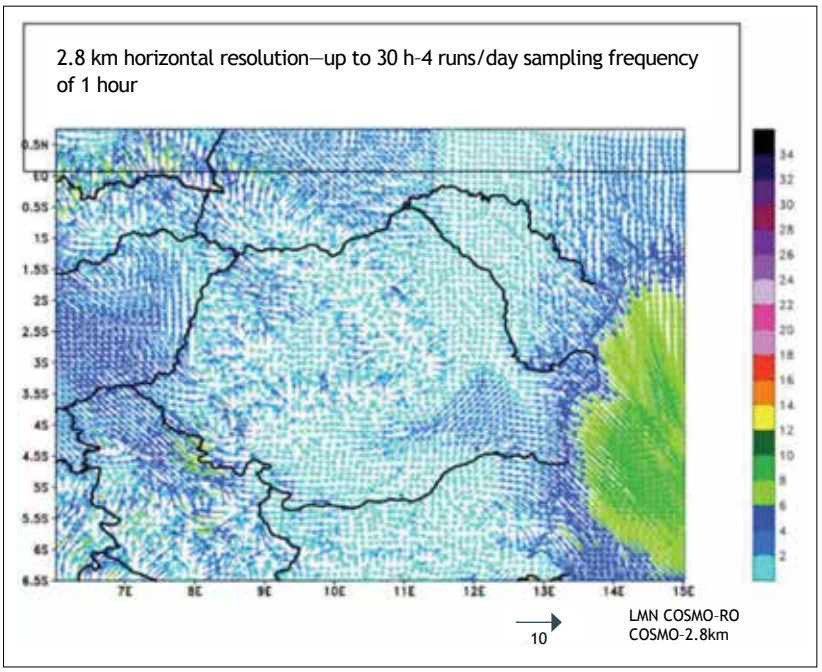

**Even the most local risks are driven to some degree by the global system.**

## The case of Romania

In Romania, the National Meteorological Administration (NMA) has a mandate to contribute to the protection of life and property against weather disasters, to monitor weather and climate, and to provide weather forecasts and advisories to central, regional, and local authorities and other stakeholders. NMA operates an observation network of fundamental importance for the country's operational meteorology and research activities. NMA cooperates with European meteorological bodies (including ECMWF, EUMETSAT, and EUMETNET) and regional projects and programs and also carries out national level projects to strengthen their core activities. For example, Figure 3 shows a 78-hour wind forecast at high resolution (2.8 km), which is computed by the Romanian COSMO model using boundary conditions from European partners and initial conditions from the national observation network.

Utilizing national resources as well as regional systems, NMA provides forecasts and warnings stemming from operational activities and specialized products to a number of national stakeholders, including governmental institutions for informational and decision-making purposes; central, regional, and local authorities in the field of environmental protection; institutions for agriculture, water management, energy, transport, and tourism; and media and citizens. With extreme weather events becoming more frequent and/or severe and having serious consequences for society and ecosystems, the disaster management and civil protection authorities are among the most important users of the information, forecasts, and warnings that the NMA provides.

Figure 3: COSMO model.




*Source:* Romanian National Meteorological Administration.

Other Romanian institutions are engaged in active research and operational activities related to identification and monitoring of hazards and their impacts and improving preparedness for disasters. The Institute of Geography has been involved in several international projects studying the impact on society and the environment of extreme events related to global environmental change. The research has been performed at local, regional, national, and transnational scales, using GIS (geographic information system), remote sensing technologies, and process-based models. The research includes case studies on vulnerability and resilience related to landslides, floods, and drought/desertification, such as the RO-RISK project (Disaster Risk Evaluation at National Level).

## Challenges

There are a number of challenges regarding leveraging regional systems to improve forecasting and warning provision at the national level:

- Availability of reliable, high-quality, and adequate resolution data (either observations or modeled data) at national level, and availability of these data to improve the reliability of regional systems
- Efficient utilization of the information and products that the regional systems provide to safeguard lives and livelihoods of people at national and local levels, especially when many systems are available

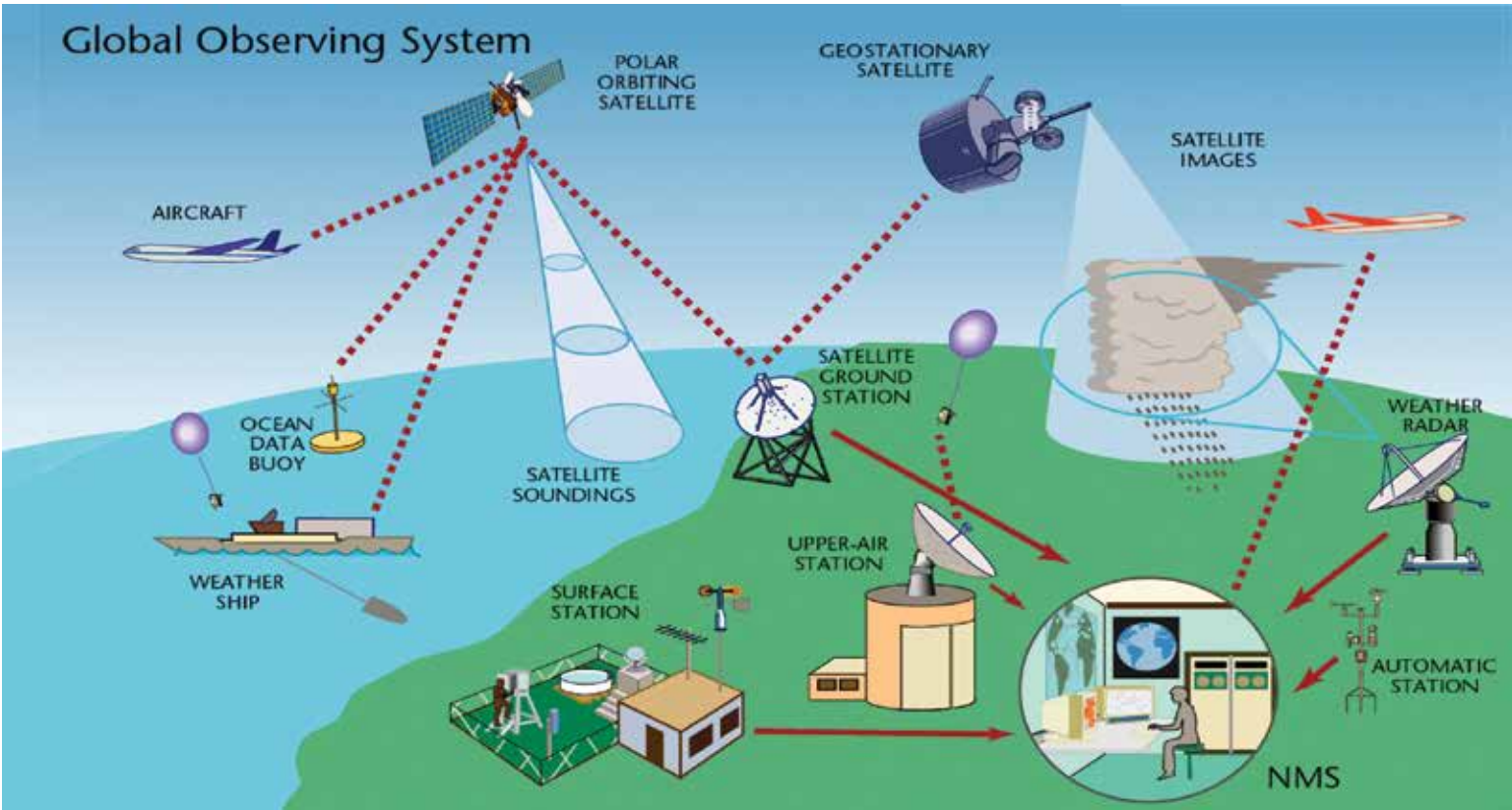
- Translation of the knowledge gained from the system to increase the response capabilities of the local communities at risk
- Clear definition of roles and responsibilities at the national level, including defining the leading roles, to ensure the appropriate cooperation with the regional institutions and program
- Continuing support of the research sector to improve the tools for monitoring and forecasting
- Possibility of taking into account national characteristics and circumstances in the development of regional systems
- Provision of training to the stakeholders who are utilizing the information from the regional systems at national and local levels

## Recommendations and Conclusion

The regional systems for monitoring and forecasting weather- and climate-related hazards significantly improve the potential of national authorities to respond in an efficient and timely manner to hazards, which are increasing in frequency and severity in Europe. A regional approach is essential since disasters are often transboundary, affecting large areas beyond country borders. Therefore, it is essential that adequate resources are available at both regional and national levels to continue the work to develop and improve the regional systems. Efforts are also needed to improve the utilization of the many regional systems available, for example by improving training and knowledge transfer, clarifying roles and responsibilities at national level (taking into account the different national and subregional circumstances), and considering new ways for developing the systems, such as implementing a multi-hazard approach.

**It is essential that adequate resources are available at both regional and national levels to continue the work to develop and improve the regional systems.**

*Source:* https://www.wmo.int/pages/prog/www/OSY/images/GOS-fullsize.jpg.



# Community engagement, raising awareness, and driving action

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## Session Summary

Understanding population vulnerabilities, raising awareness, and driving action to ensure effective disaster mitigation are critical to ensure better preparedness and better response. Better understanding of community risk is a shared responsibility that requires strong collaboration between public and private stakeholders. This session highlighted community engagement initiatives that seek to increase public awareness and catalyze citizen engagement to drive commitment to action and improve disaster preparedness at the community level.

**Seek to increase public awareness and catalyze citizen engagement to drive commitment to action and improve disaster preparedness at the community level.**


Top photo: Bucharest 'Red Dot' labelled buildings. Bucharest 'Red Dot' labelled buildings. Above: Bucharest Community Foundation—"For 7 years we have been supporting people who change Bucharest."

## Background

Communities often bear the brunt of disaster impacts. In line with the need for a more coordinated and proactive disaster risk management, the need to strengthen community engagement in all aspects of disaster risk management is now widely recognized. Experience shows that there is a high dependence on local capacity and response immediately after a disaster strikes. The Sendai Framework for Disaster Risk Reduction 2015–2030 also recommends broader community engagement in the development of international, national, and local policy on risk management and emergency response.

## Case Studies

### Bucharest Community Foundation: Bucharest Prepared program

Bucharest is the most earthquake-prone capital city in the EU because of its proximity to the Vrancea earthquake zone, which can produce earthquakes as strong as magnitude 8.1 (World Bank 2018). With a young, vibrant civil society in Romania (Calin 2019), the country's focus on community preparedness for disasters is still relatively new. Most of the small grassroots nongovernmental organizations (NGOs) and other organizations that work on this agenda are new and lack necessary funding for their ideas and projects. To address this need, the **Bucharest Prepared program**, a grant-making fund for earthquake and other major disasters, was developed by Bucharest Community Foundation. Ms. Alina Kasprovschi, the executive director of the foundation, described the program, which gathers resources and supports projects that seek to inform and educate the residents of Bucharest and to create a support network in case of an earthquake. The Bucharest Community Foundation raises funds from local businesses and individual donors to develop communities in Bucharest. The vision for the **Bucharest Prepared program** is to have no single resident in Bucharest unprepared for the next big earthquake. The first open round of calls for projects to NGOs and initiative groups took place in 2019, and it managed to raise €100,000 in financial support from IKEA, ING Bank, and Lidl. The five winning projects that received the grants include first aid training activities, search and rescue training and certification for dogs, neighborhood awareness campaigns, and enhancement of parallel radio communication systems. Given the financial support of the private companies in the first grant - making round, other private sector partners joined the program ensuring financial support, so more grant-making rounds can be planned in 2020. While the problem is bigger than what the Bucharest Program is trying to address, the Bucharest Community Foundation is working on leveling what communities themselves can do to be better prepared for an earthquake and become resilient, while coordinating with the Department for Emergency Situations, the public authority managing and coordinating disaster preparedness and response in Romania.

### San Francisco: The Neighborhood Empowerment Network

Mr. Daniel Homsey, the director of the Neighborhood Empowerment Network (NEN) for the City Administrator's Office of the City and County of San Francisco, shared the tools the organization uses for building stronger neighborhoods and more resilient communities. He made the case for why it is best to empower people to help themselves in order to have a resilient community prepared for any disaster. Mr. Homsey described how disasters impact the lives of people, such as fires in San Francisco[2] that isolated thousands of people, including his mother and her entire community, leaving them without electricity for days. He also described fires on the Greek islands that forced evacuations, and the November 2019 floods in Venice[3] that led to the highest water levels in the region in more than 50 years, leaving around 70 percent of the lagoon city center under saltwater, affecting the

[2] Reporting on the 2019 wildfire season, Cal Fire and the U.S. Forest Service counted more than 7,860 fires affecting an estimated 259,823 acres (105,147 hectares) as of December 22, 2019.

[3] Two months after the second-highest flood in its history, in November last year, Venice's canals have been left dry by exceptionally low tides.

tourism sector, and challenging the resilience of residents.

"Resilience" is understood as a way to describe how something performs when it is under stress. In a city, this can be broken into five core elements: built environment, networks, economy, institutions, and communities. A community can be understood as a group of individuals, organizations, or networks. Community "resilience" is thus about connections, capacity, and resources.

The self-sufficiency of a community is important. A community can become more resilient through the continuation of the services, energy supplies, food and water resources, communication means and transportation systems. The cooperation between public institutions, private sector and civil society is crucial in order to increase the level of resilience and to ensure the selection and implementation of the right measures for the protection of local communities (Manea 2017).

A study from the Harvard Kennedy School that builds on lessons from Hurricane Katrina shows that communities must invest today in capable local leadership that can drive rapid, substantive action, while focusing on inclusiveness and embracing self-reliance. Communities should also be able to evolve and adapt as challenges arise by developing new skills and capacities. To increase their capacity, communities should seek out and interface with outside sources of help, like government, foundations, universities, corporations, or NGOs. According to a Milken Institute School of Public Health project report related to Hurricane Maria in Puerto Rico, community engagement during the crisis, risk communication preparedness, and risk planning processes could all be strengthened by using participatory approaches and establishing strategies to capitalize on this engagement for improved communication during the response and recovery period. For example, interpersonal networks could be used to disseminate information as a complement to mass media channels.

To apply the lessons learned from Katrina, the Neighborhood Empowerment Network (NEN) takes an approach that empowers communities and guides their investment for a resilient future.[4] The NEN is a cohort of residents, government agencies, nonprofits, faith-based organizations, academic institutions, private sector actors, and philanthropic organizations that are committed to building a stronger, more connected, and resilient San Francisco. Its vision is a strong, connected city where every resident, organization, and community has streamlined access to the resources, strategies, and expertise they need to advance their individual and collective resilience. NEN's mission is to advance the leadership capacity of neighborhood stakeholders to steward their community's resilience by supporting them as they craft culturally competent resilience action plans that guide their ongoing investments at the individual, organizational, and community levels.

One of NEN's key programs is the Empowered Communities Program (ECP), through which all residents, regardless of socioeconomic condition, receive year-round culturally competent preparedness support and get the help they need to maintain their health and well-being during times of stress.[5] The approach ECP uses is to plan and design with people and not for them. The ECP receives support and resources from the member agencies of the NEN in order to create action plans, strategies, tools, and trainings that the communities use to build neighborhood resilience. It offers real value to stakeholder organizations from all sectors at all levels, and most importantly, it drives ownership at the neighborhood level through the transfer of power. Another critical program of the NEN is the ECP HUB Program, which supports neighborhoods as they create a local network of organizations that provide support to residents recovering from a stressful event, while building the overall preparedness of the community (ECP 2016). Finally, NEN also uses the popularity of block parties to build social capital, thereby strengthening the connections and trust that are highly critical in periods of stress, as they enable collective action. The Neighborfest is all about getting to know better the people that are close and about strengthening communities at the local level. The event is organized with the help of a toolkit given to the host in order to identify goals and objectives while providing a framework for roles (ECP, n.d.).

[4] For more information, see the NEN website at https://www.empowersf.org/.
[5] For more information see the EPC website at https://www.empowersf.org/ecp-communities/.

Figure 4: Neighborfest host toolkit poster.


*Source:* NEN.

Program partners have access to various benefits, such as identification of leaders who can convene local residents, distribution of communication materials to residents in a culturally competent environment, increased connectivity at the community level that can be repurposed downstream for other engagement/outreach activities, a reduction in cost and staff time to organize and engage residents, and face time with hard to reach constituents (e.g., monolingual, senior, or special needs).

### Map your ResilientVille exercise

The session ended with the presentation of a tool through an interactive exercise. The tool is called MAP, for "Map your ResilientVille," and it is used to help participants identify resources, facilities, and physical locations that will support the development of a resilient action plan in the aftermath of a disaster. This was a fun experience that allowed participants to mix and work in small groups of five to eight people with different roles, from leadership to execution. The activity started with distribution of maps of a neighborhood to each group, who were then asked to identify vulnerable people who may need help within the first days after a disaster (Figure 5). They were then asked what they could do within the first days and where they could find the resources needed on the map. Although the exercise was run in a faster version than is typical, participants were left with a feeling of empowerment after finishing the activity, showing interest in the maps used and excited to apply this approach within their organizations/communities.

## Recommendations and Conclusions

Enabling collective action requires connections and trust that can be strengthened through collaboration between institutions and the people they serve, and between academia, NGOs, and the private sector. Disasters do happen at the local level, and investing in social capital proves to be essential in times of stress and not only. Some of the tools and approaches presented in the session are easily replicated in other cities as well. As a follow-up to the conference, and given the similarities between Bucharest and San Francisco in terms of vulnerabilities to natural disasters, a pilot project may be prepared to see how some of the NEN tools can be used by the Bucharest Community Foundation and the Romanian Department of Emergency Situations to build on their mission of engaging communities and having them prepared for the next big earthquake.

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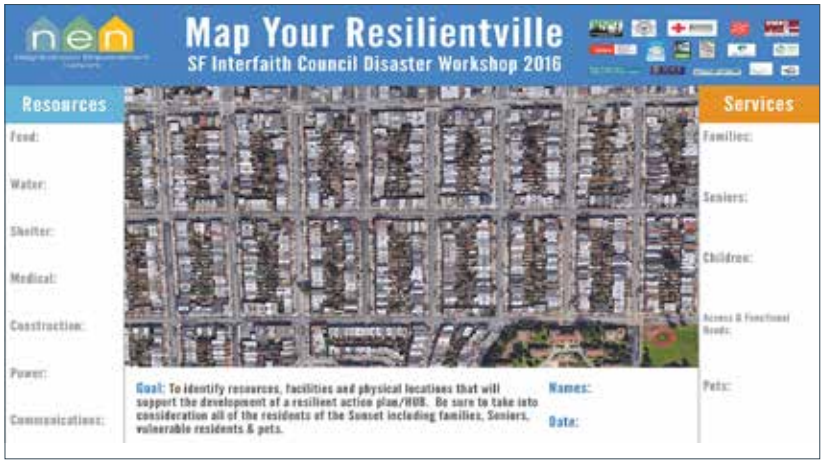
Figure 5: Worksheet for the Map your Resilientville exercise.




*Source:* NEN.

# Challenges and opportunities for assessing flood risks

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## Session Summary

This session addressed the risk of floods in the EU and the implementation of Directive 2007/60/EC, the EU Floods Directive (FD). It showed the importance of having both Member States and acceding countries involved in the preparation of flood risk management plans (FRMPs). It also highlighted the transboundary cooperation that this directive requires, as floods don't stop at country boundaries. Between 1998 and 2009, Europe suffered over 213 major damaging floods, including the catastrophic floods along the Danube and Elbe rivers in summer 2002. During the same period, floods in Europe caused some 1,126 deaths, the displacement of about half a million people, and at least €52 billion in insured economic losses. The increase in the frequency of flood events in Europe, along with associated damages, has pushed Member States to propose EU legislation to improve awareness of flood risk. In 2007 the FD was adopted by all Member States. It aims at reducing and managing the risks that floods pose to human health, the environment, cultural heritage, and economic activity.




Photo above: technotr.

There are three important messages for dealing with floods in Europe:

- First, it is urgent to promote action in the field of floods according to flood impacts, and especially in a climate change context.
- Second, the FD was prepared at the request of Member States.
- Third, this directive does not impose very stringent requirements but is mainly dedicated to raising public awareness.

## Background

The FD requires Member States to assess all watercourses and coastlines to determine if they are at risk from flooding; to map the flood extent, as well as assets and humans at risk, in these areas; and to take adequate and coordinated measures to reduce flood risk. The FD reinforces the rights of the public to access this resulting information and to have a say in the planning process. It required Member States to first carry out a preliminary assessment (by 2011) to identify the river basins and associated coastal areas at risk of flooding. For such zones, countries were required to draw up flood risk maps (by 2013) and to establish FRMPs focused on prevention, protection, and preparedness (by 2015). FRMPs are prepared for recurrent cycles of six years and are accompanied by programs of measures giving a precise idea of investment needs. Currently, all the Member States are involved in the preparation of the second cycle of the FRMP. They are required to improve their FRMPs on the basis of the European Commission's remarks, as needed.

## Case Studies

**Mr. Clemens Neuhold,** from the Austrian Federal Ministry of Sustainability and Tourism, presented the main requirements of the FD, the experience of Austria in implementing it, and the experience of cooperation at Danube scale.

**Professor Zaleski** from Poland showed how Poland is impacted by floods, including the 1997 floods, which were a major historical event in Poland. The flood losses were estimated at around €3.5 billion; 600,000 houses were damaged, 140,000 enterprises were affected, and 4,000 critical facilities and institutions were impacted. For these reasons Poland was one of the Member States that took the lead in implementation of the Floods Directive. Poland is currently preparing its second cycle of FRMPs. It is working on the three implementation stages of the FD: preliminary flood risk assessment, flood hazard and risk maps, and FRMPs and associated programs of measures. Thanks to the implementation of the FD, Poland has made progress in raising public awareness and has elaborated precise programs of measures (with associated costs) that would allow mitigation of flood impacts.

**Ms. Nataša Milic** from Serbia's Ministry of Agriculture, Forestry and Water Economy shared lessons on how an acceding country implements the Floods Directive (i.e., through preliminary flood risk assessments, flood hazard and risk maps, and FRMPs). Although Serbia is an acceding country, it is fully engaged in the full implementation of the FD by modifying its legal and institutional framework to transpose the FD, implementing its stages, and coordinating its implementation with the Water Framework Directive (2000/60/EC), in particular for public information and consultation. This proactivity by Serbia in the implementation of the FD is due to the country's long tradition of flood risk management—a response to the presence of several rivers (such as the Sava) flowing through this country and generating floods on a frequent basis.

**Mr. Sorin Randasu,** director of the Romanian Waters National Administration, described implementing the FD as part of the Danube regional cooperation. He presented the results of an Interreg program (supported financially by the European Commission) showing that riparian countries of the Danube can work together to address flood challenges and implement the Floods Directive. This Interreg program also highlights the important technical background needed to implement the directive in its three stages. The FD requires a lot a data that can be provided in different ways—e.g., digital terrain models (DTMs), satellite images, and drones surveys. These technological tools should help raise awareness of floods among a wide public.

Figure 6: Flood hazard and flooding scenarios.


*Source:* ICPDR (2015).

## Challenges

The implementation of the FD poses some challenges for Member States and acceding countries, as presented below. Nevertheless, the lessons learned from the first implementation cycle show that Members States and acceding countries have managed to address most of them, at least partially.

The Floods Directive can't be seen as a stand-alone piece of legislation. It should be carried out in coordination with the Water Framework Directive, notably by coordination of flood risk management plans and river basin management plans. Member States should also coordinate their flood risk management practices in shared (transboundary) river basins, including with third countries[6], and in solidarity should not undertake measures that would increase the flood risk in neighboring countries. For instance, along the Danube River, even non-Member States are implementing the FD and preparing flood hazard and flooding scenarios (see Figure 6).

Public participation is a key element, as all assessments, maps, and plans are to be made available to the public. The FD integrates a climate change dimension: under the FD, Member States are supposed to take into consideration long-term developments, including climate change, as well as sustainable land use practices in the flood risk management cycle. The FD serves to protect EU citizens and the economy from flood events by increasing countries' understanding of risk and promoting investment in preventive measures.

[6] A third country is a country that is not a member of the European Union as well as a country or territory whose citizens do not enjoy the European Union right to free movement, as defined in Art. 2(5) of the Regulation (EU) 2016/399 (Schengen Borders Code).

## Key Solutions and Existing Tools

The Floods Directive provides a framework for the assessment and management of flood risk for the EU (and beyond, as for instance Turkey is implementing the FD). The cyclic (six-year) implementation of the directive allows countries to build upon improvements at each cycle. Significant improvement can be achieved from one cycle to the next, by refining DTMs, using Lidar, upgrading data, improving public consultation, and reinforcing transboundary cooperation.

The three-step approach—entailing a preliminary flood risk assessment including areas of potential significant risk, preparation of flood hazard and risk maps, and preparation of FRMPs—facilitates the public ownership throughout the implementation process. The second cycle of the FD and the third cycle of the Water Framework Directive clearly demonstrate improved collaboration in the preparation of the FRMPs and river basin management plans and associated programs of measures. A number of countries are carrying out the public consultation processes of the two directives in parallel.

## Recommendations and Conclusion

A flood risk management plan is a useful tool in strategic (urban) planning. It is also crucial to define the interface between regional and local tools (civil protection). In addition, FD implementation leads to a significant increase in the availability and accuracy of data (DTM, Lidar, satellite images). The FD provides a clear, institutionalized frame for coordination and cooperation with sectors related to the overall risk cycle (e.g., spatial planning, building regulation, emergency management). The FD promotes a common understanding of flood risk at EU/international scale. It is important to improve FD implementation cycle after cycle. Although the three stages of the FD have been well tackled by Member States, it is clear today that the implementation of the recommended programs of measures is still lagging behind. It is important that adequate financial and human resources be dedicated to the implementation of the program of measures. The examples presented by the four countries show that it is possible to learn lessons from other countries. Nevertheless, these examples also demonstrate that one solution doesn't fit to all contexts.

## References

International Commission for the Protection of the Danube River (ICPDR). 2015. Flood Risk Management Plan for the Danube River Basin District.


Tourists try to stay dry in a flooded St Mark's Square, Venice, Italy. Photo: Jonathan Ford @jonfordphotos

# Private sector and business continuity: Preparing for and managing disasters

Session Contributors

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## Session Summary

The private sector is an important partner in disaster resilience, playing multiple roles and sharing responsibility with the public sector for the safety of people and, frequently, for the functioning of critical public services. When disasters strike, they can disrupt services, production, and key functions of businesses, affecting people, the local economy, and trade patterns. With increasing disaster exposure and interconnectivity of production and services, businesses need to develop forward-looking preparedness and mitigation arrangements. A range of tools is already available, such as assessments, business continuity plans (BCPs), and various risk reduction investments, which can be highly relevant for the public sector as well as for communities and households.

Understanding how the the private sector will act in an emergency, can help people be better prepared.

Photo: Nomadsoul1.

# Background

## Why is private sector resilience important?

While housing, infrastructure, and agriculture tend to accumulate the largest damages and losses in a disaster, people and business bear most of the recovery costs. Some businesses and livelihoods never recover following a disaster, contributing to loss of economic opportunities, income, and in the worst case unemployment and economic downturn. In addition, many public services are fully or partially delivered by the private sector, such as electricity or water supply. When critical services are disrupted, overall economic activity and people's lives are impacted. Finally, an important aspect to consider is the safety of the workforce and customers. In many cases, both the government and communities may rely on the private sector to provide shelter and relief goods, and later recovery items.

## Are firms prepared for disasters?

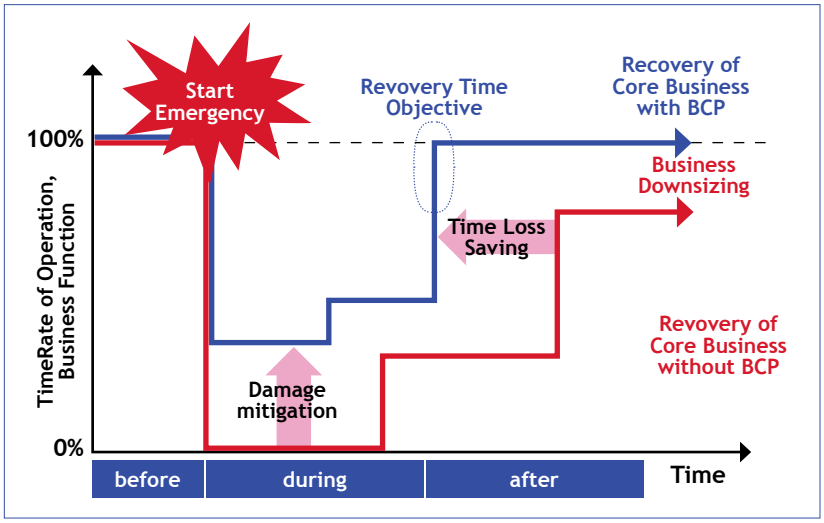
Over the past decades, many firms have improved their planning, particularly larger ones. However, a recent survey in Italy among a selection of small and medium enterprises (SMEs) serviced by the regional Federcasse Bank revealed that while the majority of responders were aware of the current and potential risks of disasters, two-thirds of the responders had no BCP that accounted for disaster risks. Further, over 70 percent of the responders had little information about existing risk reduction initiatives from the local authorities. It is likely that this also reflects the experience among many SMEs in other European countries.

**How to better prepare?** Key steps include (i) understanding risk through risk assessments focusing on different hazards or combinations of hazards, specific areas, or specific business functions, as well as interlinkages and potential impacts; (ii) continuity planning, including the preparation of a BCP; and (iii) mitigation and preparedness through the execution of physical investments to reduce disaster risk, as well as nonphysical measures such as improved communication technology/systems, drills, awareness, and regular testing and improving of plans.

## What is a business continuity plan?

A BCP can be seen as a "process to develop a practical plan for management demonstrating how, following an emergency situation, to recover or partially restore services or functions to a pre-defined and acceptable level of operation with a pre-determined timeframe" (World Bank 2018).[7] Some of the key objectives of a BCP are to avoid market share loss, reduce recovery costs, increase safety, protect sector/company reputation, enhance communication, and reduce impact to consumer/clients and the wider public. Furthermore, a plan should be practical and concrete, containing information about critical processes and organizational aspects for efficient communication and response during and after an emergency. The plan should clearly state which hazards are most relevant (in case of a multi-hazard scenario), which potential emergencies pose the biggest risk, and how these can be mitigated. Use of a BCP is illustrated in Figure 7.

**Figure 7:** Schematic illustration of the use of a business continuity plan. Source: Lifeline Utilities and Business Continuity Planning in Tuzla Istanbul.




*Source:* Lifeline Utilities and Business Continuity Planning in Tuzla Istanbul.

[7] According to World Bank and GFDRR (n.d.), a BCP "identifies potential effects of disruptions to an organization's critical operations if a disaster were to occur, and specifies effective response actions and quick recovery measures." https://www.gfdrr.org/sites/default/files/publication/knowledge-note-japan-earthquake-2-4_0.pdf

## Case Studies

Presenters shared experiences from different perspectives, including global, industrial zone, large firm, and city.

### FM Global: The global experience

The session included information based on the operational experience of FM Global across many countries, focusing particularly on floods and earthquakes.

For understanding risk, there are global data sets available, particularly for earthquake and flood risk (such as through FM Global or Dartmouth Flood Observatory, respectively), which can help in the initial scoping of disaster hazard. Understanding the scope of risk for specific facilities/operations requires detailed modeling and mapping. Related to private sector and specific facilities, it is particularly important to understand the potential extent of physical damage and estimated operational impact.

Options for reducing seismic risks (and often related fire risks) include the following: (i) creating an earthquake emergency response plan, (ii) installing sprinkling system and fire pumps with seismic bracing for sprinkler system and fire pumps; (iii) anchoring critical utilities (electric cabinets, boilers), (iv) fixing warehouse rack structures, and (v) installing seismic shutoff valves for gas piping and ignitable liquid piping.

Options for reducing flood risks include the following: (i) creating a flood emergency response plan, (ii) investing in temporary flood protection solutions for facilities (sandbags, flood logs, perimeter barriers) and assets (plastic tarps, raising equipment, relocation), (iii) enhancing preparedness by ensuring emergency power, fuel supplies, and flood pumps, (iv) investing in resilient designs (going beyond set building codes to create redundancy and take into consideration potential failure), and (v) investing in permanent solutions (such as floodwalls, curbs at openings, elevated structured for equipment, flood doors, track doors, or flood planks). See Figure 8 with select measures.

### Istanbul Tuzla Organized Industrial Zone (ITOIZ)

The session included information based on the experience of the ITOIZ, which has conducted a lifeline utility assessment and developed a business continuity plan for the zone. These can serve as examples of good practice for other industrial zones in Istanbul and beyond.

The ITOIZ BCP development included the following steps: (i) context analysis; (ii) vulnerability analysis; (iii) risk analysis; (iv) risk evaluation; (v) response and recovery options; (vi) implementation of BCP; and throughout the process (vii) stakeholder consultations.

The risk assessment took into account critical lifeline utilities (natural gas, electricity, road transportation, process water, wastewater, storm sewer, and ICT), a range of sectors (automotive,

Figure 8: Various options for temporary and permanent flood risk reduction.


*Source:* Adapted from FM Global.

steel, electronic, pharmaceutical, and others), and hazards (particularly hail, snow, floods, earthquake, and landslide). Both individual and cascading effects were analyzed. Beyond likelihood and level of hazard, the risk assessment considered duration and scale of outage. Assessment of flood hazard also took into account effects of climate change. Various consequences were established based on the level of impact (Table 1).

The assessment identified key risks, including (among others) (i) a strong earthquake with a return period of 475 years and high to very high consequences, directly or indirectly (via landslides), leading to (cascading) failure of various utilities (electricity, communication, road transport, process water, natural gas); (ii) intense rainfall with an estimated return period of 20–50 years and high consequences due to failure of the road transport system; and (iii) an earthquake with a return period of 50 years and high consequences due to failure of ICT systems.

The BCP was developed to facilitate quick response to an emergency situation so as to keep the outage of lifeline utilities within an acceptable duration to ensure (or enhance) business continuity for the zone as a whole. The BCP also includes a process by which it is reviewed and updated after an emergency based on lessons learned. As part of the BCP development, the following aspects were considered: (i) levels of acceptable risks (recovery time and acceptable rate of operations); (ii) organizational aspects in an emergency (communication tree, roles and responsibilities, activation protocol with triggers); (iii) guidance (list of measures and prioritization tool, see Figure 9) during an emergency; and (iv) implementation tasks (e.g., regular updates and reviews, monitoring, training, feedback collection, and evaluation, etc.).

## IKEA

The session included information based on the risk and compliance practice of IKEA in southeastern Europe, whose five countries contain 1 million km$^2$, 75 million people, and 30 million households.

Risk is perceived both in terms of awareness and opportunity; and it is considered as part of the whole business cycle. IKEA risk and compliance covers the following areas: (i) fire prevention and response; (ii) occupational health and safety management; (iii) security management; (iv) crisis management; (v) administration support, audit, and control; (vi) insurance; (vii) risk management; (viii) ISDP management; and (ix) product requirement and compliance. For this, a range of tools is used, including (i) code of conduct, (ii) group risk manual; (iii) security check; (iv) quality check; (v) incident reporting system (see Figure 10; (vi) CASY system; (vii)

**Table 1:** Types of consequences based on impact of event affecting ITOIZ.

| Impact level | Safety | Business continuity cost | Repair cost | Environmental impact | Reputation loss |
|---|---|---|---|---|---|
| **5 (very high)** | Several casualties | Businesses are going bankrupt, ITOIZ management unable to continue managing ITOIZ | Inability to pay for extremely high repair cost | Severe impact on the environment outside ITOIZ | Severe loss of reputation, businesses consider moving out of ITOIZ |
| **4 (high)** | Casualty | Significant loss of productivity | Repair cost exceeded yearly budget | Moderate impact on the environment within ITOIZ | Significant loss of reputation, position of ITOIZ management at stake |
| **3 (fairly high)** | Heavy injuries | Moderate loss of productivity | Repair cost exceed yearly budget | Moderate impact on the environment within ITOIZ | Slight loss of reputation, complaints of industries from within ITOIZ |
| **2 (medium)** | Minor injuries | Diversion of management from productive tasks | Part of expected exceptional maintenance and repair operations | Slight impact on the nearby surroundings within ITOIZ | Moderate loss of reputation, notices on media and complaints of industries from outside ITOIZ |
| **1 (low)** | Only material damage | Negligible | Part of routine maintenance | Negligible impact on the nearby surroundings of the affected lifeline utilities within ITOIZ | Negligible reputation loss |

*Source:* Lifeline Utilities and Business Continuity Planning in Tuzla Istanbul.

**Figure 9:** Prioritization tool as part of BCP.

| Lifeline utility | Assets | Priority and time objective | | Completely damaged | Parity available | Endangered (might fall on short notice) |
|---|---|---|---|---|---|---|
| | | | | [enter emergency location(s) id#] | | |
| **Roads needed for access to other emergency locations** | road | 0 | 3 hours | ■ | ■ | ■ |
| | associated objects and systems | | | ■ | ■ | ■ |
| **Electricity** | main cable | 1 | 8 hours | ■ | ■ | ■ |
| | transformer | | | | | |
| | associated objects and systems | | | ■ | ■ | ■ |
| **ICT** | main fibre/cable lines | 1 | 8 hours | ■ | ■ | ■ |
| | associated objects and systems | | | ■ | ■ | ■ |
| **Process water** | pipeline network | 2 | 16 hours | ■ | ■ | ■ |
| | associated objects and systems | | | ■ | ■ | ■ |
| **Natural gas** | gas pipeline | 3 | 1 day | ■ | ■ | ■ |
| | associated objects and systems | | | ■ | ■ | ■ |
| **Roads** | road | 3 | 1 day | ■ | ■ | ■ |
| | associated objects and systems | | | ■ | ■ | ■ |
| **Storm sewer** | rainwater sewer system | 4 | 2 days | ■ | ■ | ■ |
| | associated objects and systems | | | ■ | ■ | ■ |
| **Waste water** | main sewer | 5 | 1 week | ■ | ■ | ■ |
| | associated objects and systems | | | ■ | ■ | ■ |

■ Highly critical objects ■ Medium critical objects ■ Low critical objects ■ Is not expected to occur

*Source:* Lifeline Utilities and Business Continuity Planning in Tuzla Istanbul

crisis management manuals; (viii) trust line; and (ix) risk management process.

As part of the established risk management practice, risk assessments are conducted with risk response options (accept, avoid, transfer, and mitigate). Impact assessment also considers the impact on people, impact on business, and external impacts. The intensity of disaster also takes into account the urgency of decision, and the possibility to continue normal business with systems and routines in place. Crisis communication helps to (i) define an overall communication approach; (ii) map internal and external stakeholders; (iii) define a spokesperson; and (iv) draft a holding statement.

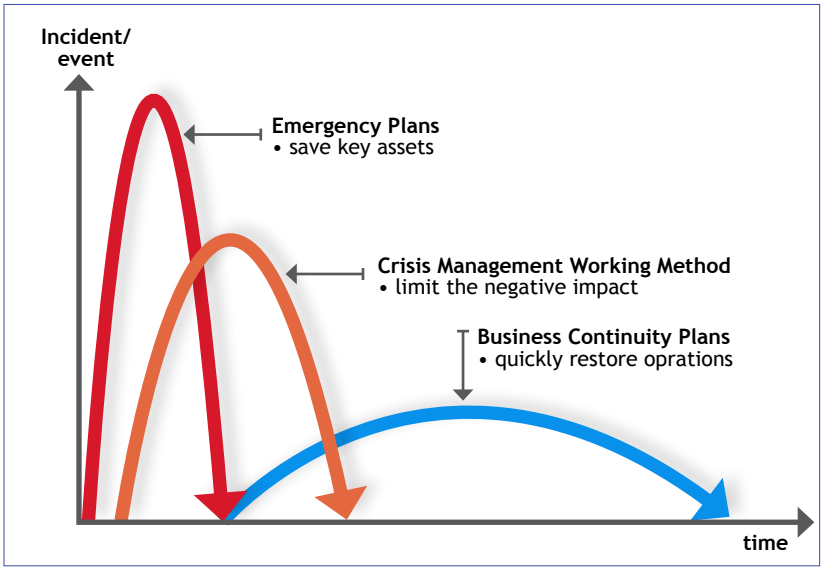
## Private sector collaboration with nongovernmental sector in Bucharest

The session presented information based on the experience of the Bucharest Community Foundation, an umbrella nongovernmental organization (NGO), which raises funds from local business and individual donors to fund projects in Bucharest and Ilfov, in Romania.

Bucharest is one of Europe's cities most vulnerable to earthquake. It is estimated that one in four people in Bucharest could be impacted by a major event. Many public assets, including hospitals, schools, and kindergartens, are vulnerable to seismic impact.

Since 2019, Bucharest Community Foundation has partnered with Endava, Enel, IKEA, ING Bank, and Lidl in a grant-making program with the objective to inform and educate the city's residents about disaster risks and preparedness. The foundation, through its networks and cooperation with NGOs, leverages and supports initiatives at the local level. For example, as part of the Bucharest Ready program, 10 search and rescue dogs have been trained and are in the process of certification. Late in 2019, two of them were part of Romania's relief efforts after the Albanian earthquake. The general population is being trained in first aid, a practice that is infrequent in Romania. And in the most vulnerable part of Bucharest, its historical center, inhabitants are being informed about and trained in preparing for an upcoming disaster. The foundation provides monitoring of funds used

Figure 10: General incidence response approach.




*Source:* IKEA.

and communication of impacts, including visibility to the partners supporting the program.

The program also supports the creation of a support network in case of an earthquake. Through regular meetings and calls for proposals, the foundation supports knowledge transfer and sharing of experience in BCP and risk management between the private sector partners as well as the NGOs engaged with the foundation. For the private sector actors, this program has also created an opportunity to better understand the needs and priorities of their customer base, which can in return inform their own process in ensuring personnel safety and business continuity planning in general.

## Recommendations and Conclusion

There are many benefits in enhancing private sector resilience. Better private sector resilience directly contributes to public sector resilience, as well as household/individual level resilience, and vice versa, since resilience is a shared responsibility among the various sectors and stakeholders.

There is a need to raise awareness of this issue. This can be done by the government—for example, by making information or case studies available, championing firms within the private sector sharing their experience, or collaborating with the NGO sector.

Understanding the scale and potential impact of hazard can be complex. However, there are tools, data, and methods available to companies to assess and better manage the risks they are facing. In doing so, firms need to shift from a "disaster-based" to a "consequence-based" perspective in strategy development. For smaller companies, starting with preparing for a small disaster can be a first step before planning for more complex ones.

Preparing a BCP is crucial for better preparedness. Private companies should formulate their BCPs to reflect the results or outcomes they expect from implementation, rather than include specific measures to counter specific disasters. They should identify key services, and examine how long the service will be disrupted and how they can shorten the disruption time (GFDRR and World Bank n.d.). As part of this process, key success ingredients include risk assessment; stakeholder consultations; agreement on priorities, actions, and responsibilities; and drills and continuous awareness related to the BCP to ensure successful implementation in case of a disaster. For interconnected disasters, another ingredient is cross-departmental or cross-sectoral coordination.

## Further Resources

AHA Centre, JICA (Japan International Cooperation Agency), OYO International Corporation, Mitsubishi Research Institute, Inc., and CTI Engineering International Co., Ltd. 2015. "Planning Guide for Area Business Continuity: Area BCM Toolkits. Version 2."

GFDRR (Global Facility for Disaster Reduction and Recovery) and World Bank. n.d. "Knowledge Note 2-4. Cluster 2. Nonstructural Measures: Business Continuity Plan." https://www.gfdrr.org/sites/default/files/publication/knowledge-note-japan-earthquake-2-4_0.pdf

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# Determining disaster and climate impacts on the poorest and most vulnerable, and optimizing solutions for resilience

Session Contributors

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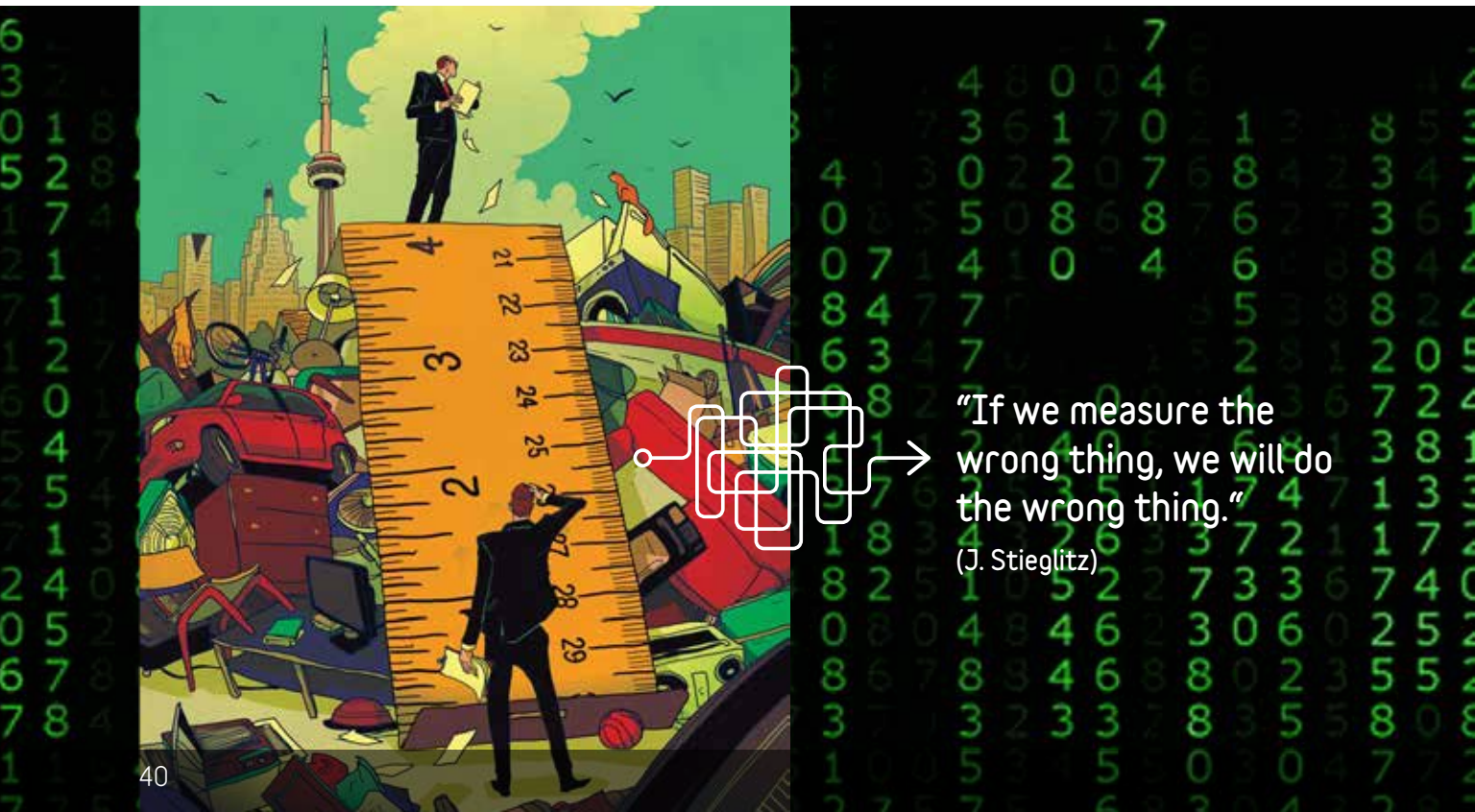
## Session Summary

Disasters affect not only households' assets but also their incomes and their consumption. Disaster effects can persist long after the physical hazards recede, forcing households to make difficult trade-offs between food, education, and health care expenditures on the one hand, and replacement or reconstruction of assets on the other. Effects of severe or successive disasters can be seen in reduced educational attainment, stunting, transient and even chronic poverty, and depressed macroeconomic growth. These multidimensional impacts depend not only on the physical attributes of a given disaster, but also on socioeconomic characteristics of affected populations. For example, wealthy households generally have access to a wide variety of coping mechanisms, which are not necessarily accessible for poor households. Critically, such differences affect not only the severity of a shock's impact on household consumption and welfare, but also the duration of recovery. >



"If we measure the wrong thing, we will do the wrong thing."
(J. Stieglitz)

> How can recovery be accelerated, when disasters cannot be fully prevented? How can decision makers effectively identify and support population groups who had very little to begin with, as well as those who tend to lose a lot during disasters? And what are the hidden costs that emerge when recovery is delayed? This session explored these questions and explained how socioeconomic characteristics can help predict in advance which households are likely to recover on their own, and which ones might require significant external assistance to facilitate their recovery.

## Case Studies

### Upcoming investment priorities and targeting strategy of Romania's Ministry of European Funds with regard to disaster resilience and social inclusion

In her opening remarks, Director General Mihaela Toader (Ministry of European Funds) provided an overview of the Government of Romania's upcoming potential priority investments for the 2021-27 programming period for EU funds with regard to disaster risk management (DRM) and environmental protection. She particularly highlighted the impact of EU funds on the maintenance and modernization of Romania's infrastructure and services related to emergency management and risk prevention, as well as the importance of using accurate, community-centered indicators in enhancing social inclusion and disaster resilience interventions.

### Building the resilience of the poor in the face of disasters and applying the Unbreakable model to Romania

In the conventional practice of DRM, disasters are measured by direct damages, or the replacement cost of assets damaged or destroyed by a shock. Indirect costs—including not only lost productivity and services, but also human capital losses—are not incorporated into cost-benefit analyses in any systematic fashion. Yet better access to relevant data and research methods doesn't just allow estimates of what is lost in terms of assets, but can also determine who is most likely to be affected and how severe socio-economic impact can be as a result of a given disaster event, and how to better formulate inclusive and well-targeted interventions.

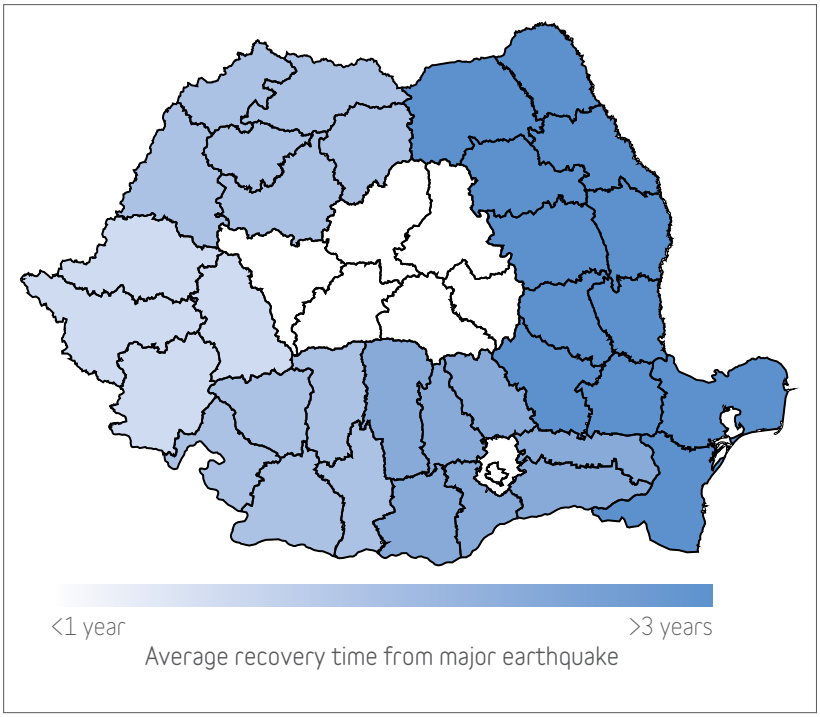
For example, the World Bank *Unbreakable* report (Hallegatte et al. 2017) uses a new method for quantifying disaster damages, while considering the unequal burden of disasters on the poor (Figure 11). This research presents a more comprehensive quantification of disaster costs, beyond direct damages; for the purposes of this session, the distribution of disaster costs among the population of Romania was examined. This new approach is also necessary because challenges—including rapid urbanization, inequality, and climate change—threaten to drive asset exposure and vulnerability higher, and to overwhelm existing DRM solutions.

The research has shown that indirect costs can far exceed direct damages, particularly when affected households have low socioeconomic resilience, meaning they lack means to cope with and recover from shocks. In

Figure 11: "*Unbreakable*" is a roadmap developed by the World Bank and Global Facility for Disaster Reduction and Recovery (GFDRR) to help countries better adapt to climate change, and boost the resilience and prosperity of their most vulnerable citizens. By equipping the most vulnerable with the means to cope, rebuild, and rebound, decision makers can increase the chance for millions to stay out of extreme poverty.


*Source:* Hallegatte et al. (2017).

Figure 12: The map shows that if a major earthquake were to strike in southeastern Romania, which includes Bucharest, the surrounding regions would take several times longer to recover and rebuild their assets than the capital city.




*Source:* Walsh et al. 2020 (forthcoming) (World Bank).

particular, recovery is often most difficult for poor and near-poor households, with the result that many become trapped deeper in poverty, even years after public recovery efforts have concluded. This situation can have permanent impacts on the welfare and long-term prospects of these households, in addition to the significant macroeconomic costs of chronic poverty. For example, in Romania, the model confirmed that rural areas in the eastern regions would take the longest to reconstruct 25 percent of their assets in the aftermath of a moderate earthquake event, even though the most valuable losses would be in the capital (Figure 12).

The risks posed by disasters are rising most acutely for the poor and other marginalized groups, whose welfare and long-term prospects have always been critically vulnerable to exogenous shocks. Both poverty eradication and shared prosperity will require more equitable DRM perspectives and solutions.

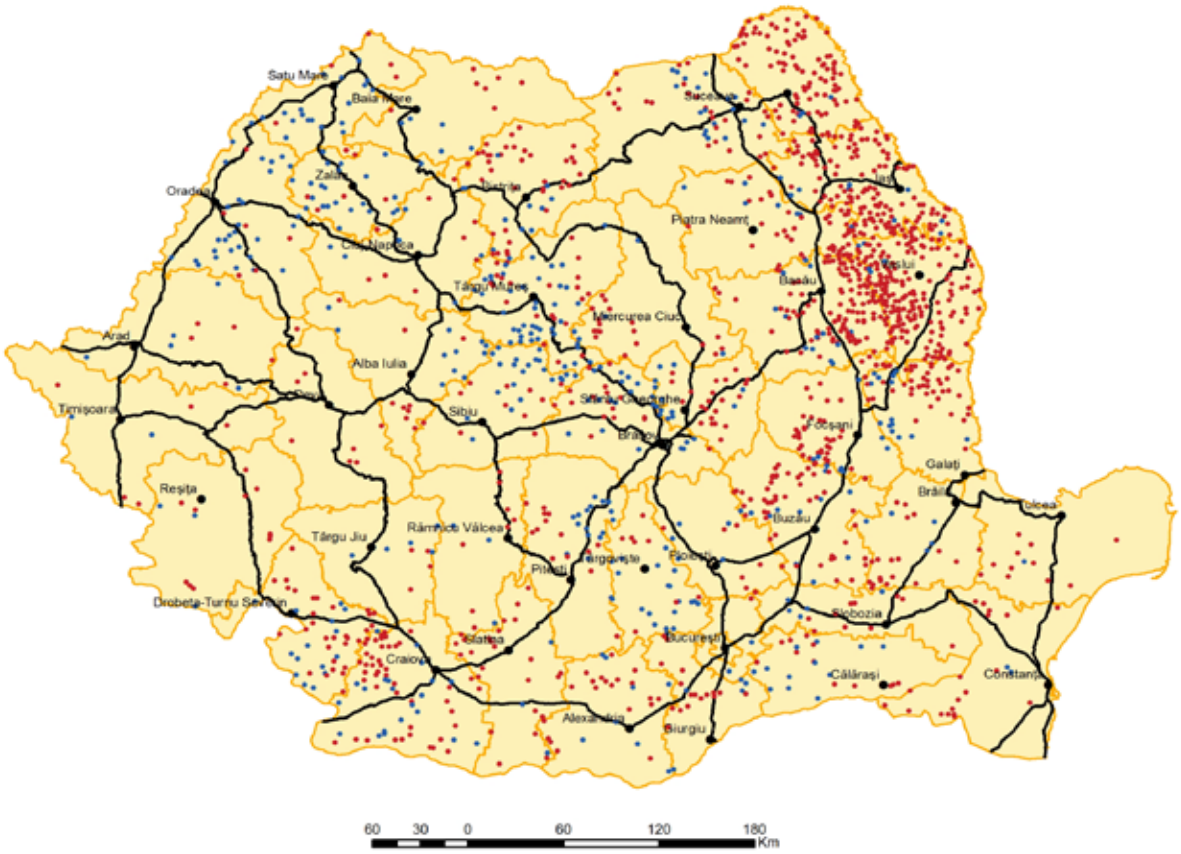
This methodology has been applied in several countries to help develop DRM strategies that incorporate socioeconomic resilience, or the relative capacities of communities, economies, and other networks to recover from shocks. Informed by a more inclusive accounting of disaster costs, this methodology identifies new justifications to invest in disaster risk reduction, and new policy tools with which to do so. In this way, resilience leads to greater equity even as it reduces the costs of disasters and of DRM, and it can help prioritize interventions in a way that integrates DRM into wider development agendas.

## Improving socioeconomic resilience across Romania: How to best target interventions?

In Romania, from a poverty alleviation perspective, marginalized areas—in both urban and rural areas —are defined and empirically identified as census sectors that experience simultaneous severe deprivation in three areas: human capital, employment, and housing conditions. The populations living in these areas are characterized by a deficit of human capital, tend to generate revenue from the informal sector (combined with social transfers and agriculture in rural areas), and often live in precarious dwellings even by the usual low standard for rural housing. Such areas are therefore territorial concentrations of

There are significant differences between marginalized areas that are urban (ghettos, slums, *mahalas*, social housing concentrations, and historical areas) and (as shown in Figure 13) those that are rural. While urban marginalized areas often localized centrally (as shown in Figure 14), rural marginalized areas are prone to geographic isolation and are usually located at the outskirts of well-connected villages. In terms of percentage of population, 6.2 percent of Romania's rural population and 3.2 percent of its urban population live in marginalized areas (estimates based on the 2011 Population and Dwelling Census).

**Figure 13:** Distribution of rural marginalized areas across Romania, 2011.




*Data source:* NIS, Population and Housing Census 2011. Cartography: ESRI, ArcGIS 10.1.

*Source:* Sandu et al. 2016.

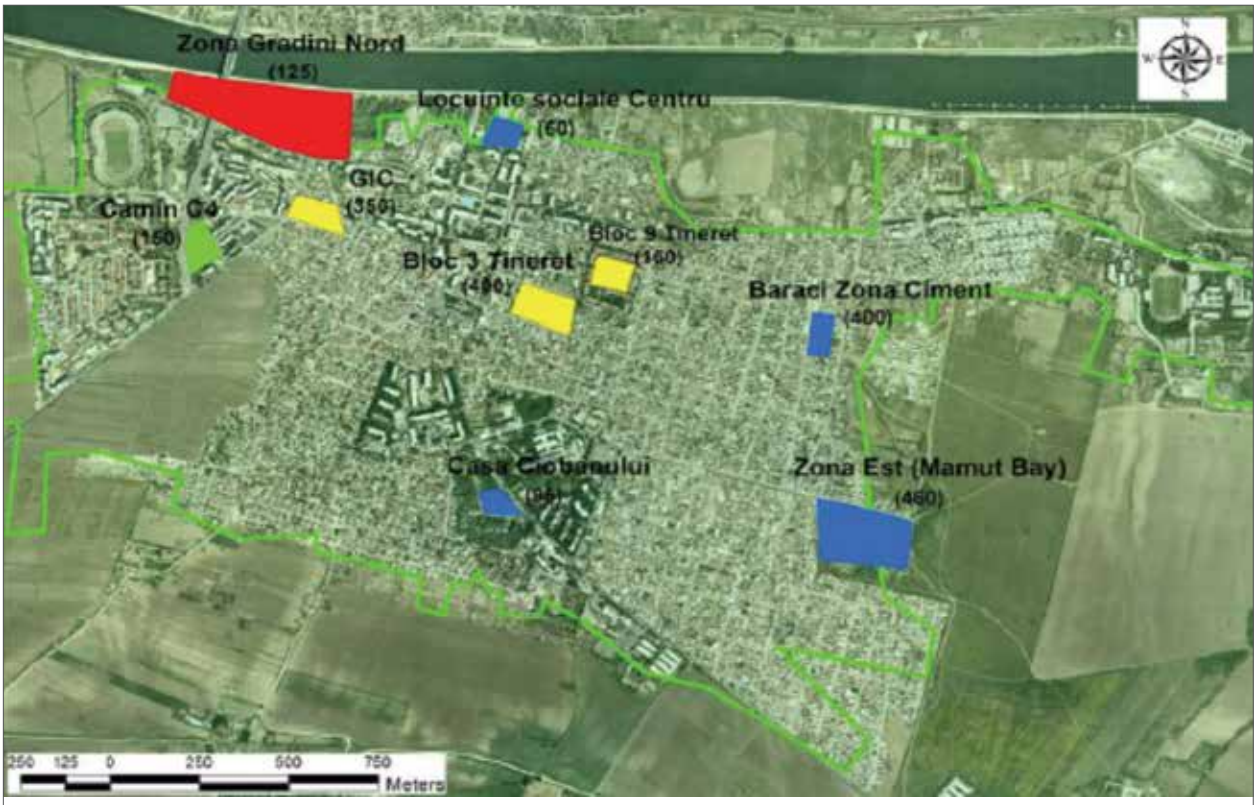
*Note:* World Bank estimations were based on data from the 2011 Population and Housing Census. The analysis was carried out at the census sector level for all rural administrative units. Sectors with fewer than 50 inhabitants were not included in the analysis.

The main targeting tools utilized for the analysis of marginalized areas in Romania are *The Atlas of Urban Marginalized Communities in Romania* (Anton et al. 2014) and *The Atlas of Rural Marginalized Areas and of Local Human Development in Romania* (Sandu et al. 2016).[8] These tools demonstrate that in Romania both the urban and the rural marginalized areas spread across all counties and regions, concentrating in the North-East region. Most rural marginalization areas are small (under 500 inhabitants) and have an ethnic dimension, as Roma people are statistically overrepresented and concentrated in segregated communities. The main limitation of the existing targeting tools is the lack of municipal geographical references, which sometimes prevents the data from shaping interventions in such target areas.

For both rural and urban areas, the empirical evidence generated in both atlases confirmed that marginalized communities disproportionately face high exposure to hazards and have

[8] In 2012, the Government of Romania and the World Bank partnered to facilitate the preparation and implementation of projects funded by the European Union. This agreement included these two atlas initiatives, which were framed within a wider project of designing strategies for the integration of poor areas and disadvantaged communities across Romania.

Figure 14: City maps with marginalized communities reported by the local authorities: Medgidia town example.




**Legend**

City limit

(number) Estimated number of inhabitants in the area.

Cartography: ESRI, ArcGIS 10.1.

- Ghetto-type areas with blocks of flats
- Ghetto-type areas in former industrial colonies
- Slum-type areas with houses
- Slum-type areas with improvised shelters
- Areas with modernized social housing
- Historical (central) neighborhoods with social housing and/or buildings abusively occupied
- Mixed areas

*Next to marginalized communities, the local name and the estimated number of imhabitants are shown, only if and as declared by the local authorities.*

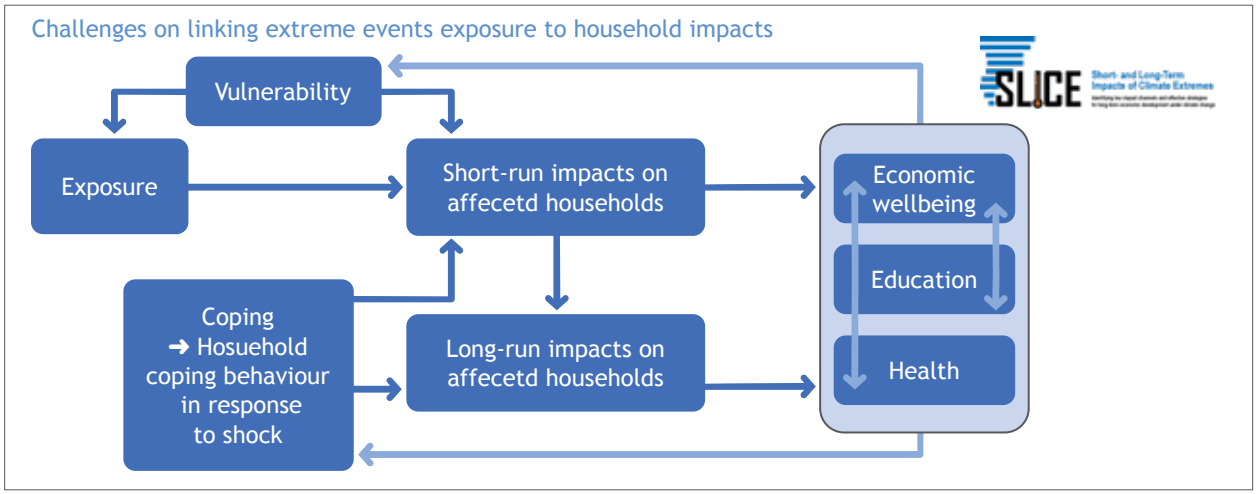
*Source:* Anton et al. 2014.

access to very limited resources to cope with and recover from such shocks (both at the household and community levels). Poverty reduction efforts in Romania could thus generate significant disaster risk reduction dividends if interventions prioritize the targeting of marginalized areas in both urban and rural zones.

## Socioeconomic impacts of climate-related extreme events: How to assess short and long-term impacts on households?

The growing socio-economic impacts of climate-related extreme events at a household level can also be seen in other regions, given that climate change poses a pervasive risk globally. The current level of global warming has already nearly tripled the proportion of the global population exposed to extreme events each year compared to the pre-industrial era. In light of this, the Potsdam Institute for Climate and Climate Analytics (PICC) is spearheading analytical efforts to better grasp the socioeconomic impacts of climate-related extreme events, and showcased preliminary results during the session from ongoing research projects: the Inter-Sectoral Impact Model Intercomparison

Figure 15: Linking biophysical risks with socioeconomic impact at household level.




*Source:* SLICE Consortium.

Project (ISIMIP) with the associated ISIpedia, and the Short- and Long-Term Impacts of Climate Extremes (SLICE) project.

While the ISIMIP project synthesizes the scientific knowledge from a multitude of climate impact models for different sectors, the ISIpedia project makes this synthesized knowledge accessible to scientific and nonscientific stakeholders. It is currently building up an open climate-impacts database, including country-level risk profiles providing information on how the country is projected to be affected by climate-related risks such as floods and droughts for different levels of temperature increases in the future.

The SLICE project analyzes the socioeconomic short- and long-term impacts of climate extremes, especially impacts on well-being, health, and education (Figure 15). Based on household-level data for Nigeria, it can be seen that households affected by flooding have partly responded to the shock by selling assets, reducing food consumption, or even taking their children out of school. In the project, the consortium analyzed the different impact channels on economic well-being, education, and health, as well as the links with exposure, vulnerability, and coping, using household data. Based on these findings, policy implications were formulated demonstrating how socioeconomic impacts of extreme events in the most vulnerable households can be reduced through poverty reduction interventions.

## Recommendations and Conclusion

All speakers in this session examined the intricate linkages between disaster and climate risk and manifestations of chronic poverty, and put forward different examples that showed how poverty alleviation and disaster risk reduction are intrinsically linked and can generate noteworthy benefits in the long term. Today, with access to a variety of tools, data sets, best practices, and other innovations to better understand, identify, and communicate disaster risks, decision makers can rethink the ways we measure these shocks so they can better track and identify who could be the most impacted, and why.

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# Scaling up safer and higher-quality learning environment

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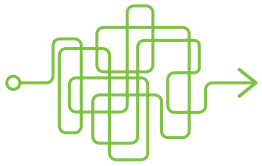
## Session Summary

Provision of safer schools should not be a matter of stand-alone policy, for two reasons. First, safety is required but not sufficient to ensure a good learning environment. Second, the implementation of safety as a stand-alone policy is wrongly perceived by beneficiary communities as the benefit is often not visible for the school community. The implementation of the actions to improve the safety of school infrastructure should be integrated into a broader school infrastructure program; or it should address the improvement of functional conditions where a broader program does not exist. This session brought together global experience in improving the safety of school infrastructure to better withstand natural disasters and climate change, in articulation with upgrades on functional conditions. It promoted a debate on key factors to scale up actions on the ground and maximize benefits for children.



"Nowhere else in the world is a center of population so exposed to earthquakes originating repeatedly from the same source."

—**Charles Richter,** 15 March 1977, Letter to the Government of Romania.

New or renovated schools are badly needed to replace ones built in the 1950s or earlier that have fallen into disrepair. Georgia. Photo: Givi Pirtskhalava/World Bank.

## Background

Every year, around 2,500 children on average could die due to the earthquake-induced collapse of school buildings if no measures are taken to reduce the vulnerability of existing infrastructure.[9] Because of earthquakes and hurricanes, 35,000 classrooms could be lost every year, and around 800,000 children might need to attend school in temporary classrooms. The main challenge in addressing this problem is its scale. Initial estimates from the World Bank's Global Program for Safer Schools indicate that around 1.1 million school buildings around the world require intervention to improve both their performance in a hazard event and their functionality.

## Case Studies

In Portugal, a modernization program has been implemented by Parque Escolar to improve the seismic performance and functionality of public secondary schools built prior to 1983 in the most earthquake- prone areas in the country (Figure 16). Parque Escolar is a state-owned company that was in charge of the implementation of intervention works in more than 330 schools in Portugal. The portfolio of public secondary schools in Portugal comprises around 400 schools. Of these, 23 percent were built in the early 1960s, just before or shortly after the publication of the Code for Building Safety against Earthquakes, RSCCS (decree no. 41658, 1958); 46 percent were built in the 1980s, with a significant proportion predating 1983, when two important codes came into force, the Code for Safety and Actions for Building and Bridge Structures, RSAEEP (decree-law no. 235, 1983), and the Code for Reinforced and Prestressed Concrete Structures, REBAP (decree-law no. 349-c, 1983) (Proença and Gago 2011). Vulnerability studies conducted by local technical institutions in Portugal concluded that secondary schools built prior to 1983 were vulnerable to earthquakes. Parque Escolar implemented works to preserve and modernize Portugal's school building heritage by upgrading its architectural and functional conditions while improving the seismic performance of buildings in earthquake-prone areas. The seismic retrofitting component of the intervention was tested in the pilot phase of the modernization program and is being progressively adopted in subsequent phases, particularly in schools in Lisbon, Tagus Valley, Alentejo, and Algarve, which have the highest seismicity in the Portugal mainland.

In Romania, there are more than 25,000 school buildings, 40 percent of which are over 50 years old. More than 25 percent of schools lack adequate heating systems and rely on fireplaces as the main heating source. Only 30 percent of schools have mobility access ramps and only 15 percent have handicap-accessible toilets. Rural schools tend to be in poorer condition than urban schools. For instance, 60 percent of primary or secondary rural schools lack libraries, and 72 percent do not have laboratories. The situation is better in urban areas, where 20 percent of schools do not have a library and 30 percent do not have laboratories. The poor condition and performance of school facilities, especially in rural areas, has contributed to unequal education outcomes in Romania. In rural areas, more than 25 percent of the population ages 18–24 are early school leavers, as compared to 6 percent in urban areas and 10 percent on average across the EU. Local seismologists and specialists in earthquake engineering identified areas in Romania that are highly exposed to damaging earthquakes, including Bucharest. In Bucharest alone, more than 25 percent of the existing 436 buildings serving 259,000 students require intervention, including some high-seismic-risk buildings.

The real dimension of the problem across the country is largely unknown, since data still need to be processed and analyzed, but local specialists estimate that thousands of school buildings across Romania might require functional improvements (energy efficiency, water and sanitation conditions, better and more inclusive learning environments) and seismic retrofitting. The strategy for modernizing education infrastructure in Romania aims to (i) develop transparent and evidence-based decision-making processes, (ii) invest in safe and flexible learning environments that facilitate innovation in teaching and learning, (iii) establish a coherent framework for funding and regulation related to education infrastructure, and (iv) provide equity, by giving access to the same quality of learning environment in both urban and rural areas and by supporting inclusion for students with special needs.

[9] World Bank Global Program for Safer Schools, "Global Library of School Infrastructure (GLOSI)," https://gpss.worldbank.org/en/glosi.

## Challenges

- **Nothing happens without the will of the government.** The decision to invest and intervene in school infrastructure at large scale presents both technical and political challenges. All agencies involved need to gain a common understanding of the intervention requirements and potential solutions, and an informed dialogue among decision makers needs to be ensured. Leading this process should be the government's entity in charge of managing school infrastructure, supported by relevant agencies.
- **School infrastructure safety is not a black and white issue.** Perhaps the only common global understanding about safer schools is that no children should die or be harmed in the event of a natural disaster as the result of a failure of school infrastructure. This aspiration varies among countries in the realm of public policy, however. On one hand, there is no such thing as "zero risk," and elements (that is, buildings, their contents, and people) exposed to natural hazards can never be absolutely safe in any given place or time. Disaster risk management therefore focuses on reducing the probability of adverse consequences, which means societies will always have to deal with some level of risk. On the other hand, risk encompasses not only physical consequences but also indirect impacts from the cumulative effect of alterations to the children's physical, environmental, social, and emotional well-being. The concept of physical safety is nuanced, and the level of "acceptable risk" (that is, the socially accepted level of risk remaining once measures have been taken to reduce risk) tends to vary across countries and communities.
- **Safety is just one of the conditions a good learning environment should meet.** Provision of safer schools should not be a matter of stand-alone policy for two main reasons. First, safety is required but not sufficient to ensure a good learning environment. Second, the implementation of safety as a stand-alone policy is wrongly perceived by beneficiary communities as the benefit is often not immediately understood by the community.
- **Low institutional capacity is an additional burden for governments trying to move toward a risk reduction approach and to carry out medium- and long-term planning.** Managing a large stock of school infrastructure is complex and requires sufficient institutional capacity. Improving the quality of existing infrastructure is usually expensive and disruptive of education services. However, it is important to integrate and optimize the need to improve existing infrastructure (safety and functional aspects) with the demand for new classrooms through medium- and long-term planning.

Figure 16: Example of school made of load bearing masonry walls with reinforced concrete floors.

*Source:* António Sousa Gago.

Figure 17: Roadmap for Safer and Resilient Schools.


*Source:* World Bank's Global Program for Safer Schools.

- **Reducing the vulnerability of a large stock of school facilities is a medium- to long-term effort.** Improving the performance of thousands of school buildings is, in itself, an enormous task in terms of resources, planning, and implementation. Competing needs, like functional improvements or new classrooms, can make the challenge for governments even more difficult, and in the many years it may take to complete these interventions, some schoolchildren will remain at risk. Maximizing the safety benefits and cost efficiency of the investments must therefore be a priority of a safer school program.

## Solutions

The Roadmap for Safer and Resilient Schools (RSRS) provides a methodological framework that can be adapted to a local context and tailored to the specific needs and capacity of the government (Figure 17).[10] The RSRS is not intended to be prescriptive; it is a guide through a process. Its eight steps follow a logical sequence, from diagnosis to analysis to planning at scale, with each step addressing the different factors contributing to disaster risk. The RSRS methodology focuses on large school portfolios and on addressing the issue of scale. As a result, the roadmap has primarily been implemented at national scale, covering thousands of school facilities and buildings. Recently, though, implementations at the municipal level have shown promising results. Although some adjustments are required at this scale, the methodology provides a plan that municipalities can use to identify and prioritize school infrastructure interventions and investments, since local governments are usually directly involved in managing them.

## Recommendations and Conclusion

The quality of education infrastructure directly affects students' learning. The implementation of investments on school infrastructure resilience should be integrated into a broader school infrastructure program; or it should address the improvement of functional conditions where a broader program does not exist. Understanding disaster risk in school infrastructure typically involves at least three levels of complexity: multidimensional risk factors, multi-stakeholder environments, and issues relating to scale. In this context, the decision-making process requires a structured dialogue through which stakeholders can achieve consensus around the roots of the problem, attain an understanding of the potential consequences of future hazard events, and identify opportunities to reduce risk. Creating this enabling environment allows policy makers to make more informed decisions about investments and policy reforms that will lead to safer, resilient, and high-quality learning environments at scale.

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[10] For more information see World Bank Global Program for Safer Schools, "The RSRS at a Glance," https://gpss.worldbank.org/en/roadmaps/rsrs-glance.

# Building urban resilience: Integrating climate and disaster risks into urban development

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## Session Summary

In cities around the world, rapid urbanization and climate change are increasing disaster and climate change risks, and new risks are emerging due to technological, biological, and other exogenous threats. For example, globally, by 2030 climate change and natural disasters may cost cities worldwide $314 billion annually and push 77 million urban residents into poverty. However, it is possible to guide development into safer areas, ensure resilience of buildings and critical infrastructure, strengthen response functions, and improve governance and institutional capacity.

Access to information about which assets and geographical areas are at highest risk from different threats is key to prioritizing actions that have the greatest potential to reduce risk; it can also lead to cost savings and increased efficiency in public spending. There is a range of innovative spatial planning tools and approaches available to cities to improve their decision making and planning, and many cities are already taking critical steps forwardto build their resilience.



Twilight over Thessaloniki, Greece. Photo: Gfed.

This session featured examples from across the European region to demonstrate recent experience and insights into how city planners and decision makers are approaching resilience, including their application of spatial data and technologies. The session also highlighted some of the challenges elected representatives and city officials have faced and how these have been overcome.

## Background

There is no single definition of urban resilience, but the two most widely used are from the World Bank and the 100 Resilient Cities initiative. The World Bank defines it as "the ability of a system, entity, community, or person to adapt to a variety of changing conditions and to withstand shocks while still maintaining its essential functions" (World Bank 2016). The 100 Resilient Cities initiative calls it "the capacity of individuals, communities, institutions, businesses, and systems within a city to survive, adapt, and grow no matter what kind of chronic stresses and acute shock they experience (100 Resilient Cities)."

Urban resilience seems most often raised in the context of population growth and human migration, but even in countries across Europe—some not experiencing very high urbanization pressures and others even seeing a decline in population numbers—resilience investments cannot be ignored. Failing to invest in making cities more resilient to natural disasters, shocks, and stresses will result in significant human and economic damages—with the urban poor bearing the brunt of losses. If high climate impact coincides with inequitable access to basic infrastructure and services, natural disasters will force tens of millions of urban dwellers into extreme poverty and may cost cities worldwide $314 billion each year by 2030, up from around $250 billion today (World Bank 2016).

## Case Studies

Three case studies were presented: (i) a national government perspective from Romania, with a specific focus on coordination and communication in disaster preparedness and response across different spheres and levels of government; (ii) an account of Thessaloniki (Greece), demonstrating how a deep understanding of the unique resilience challenges in a locality can stimulate supporting investments at city level, in this case a particular focus on a waterfront development; and (iii) an example from Lisbon (Portugal), showing how an in-depth understanding of the landscape and climatic conditions, coupled with a multi-departmental approach to prevention of disasters and rapid response, results in strengthened resilience of a city and its residents.

### Romania

Romania faces one of the highest risks of earthquake among European Union countries. Thousands of lives have been lost and tens of thousands of buildings damaged in earthquakes over the last 200 years. More than 75 percent of the population, including 65 percent of the urban population, is in areas with high earthquake hazard. Moreover, 45 percent of all critical transport, energy, water, and communication services, as well as 70–80 percent of the country's gross domestic product (GDP), are in seismic zones. The effects of climate change have also substantially increased in recent decades, bringing more frequent landslides, wildfires, droughts, floods, and extreme weather events. In 2006, for example, extreme floods caused economic damage equivalent to 1 percent of GDP.

Romania has been working to effectively prepare for, and respond to, natural disasters and climate change by strengthening institutions and legislation. The effort is being led by the General Inspectorate for Emergency Situations within the Ministry of Internal Affairs. The General Inspectorate has three main tasks: (i) coordinate the implementation of emergency management actions and measures in the national territory; (ii) coordinate all organizations involved in the management of emergencies according to international

**"The 19th century was a century of empires. The 20th century was a century of nation states. The 21st century will be a century of cities."**

**—Wellington E. Webb,** former Mayor of Denver

regulations; and (iii) communicate the decisions made by the government or by the National Committee (through its Technical Secretariat) to the authorities of the central public administration in order to secure coordinated management of emergencies. The country has been using various tools to engage local communities to prepare for emergency situations, working with local authorities and using technology and social media to share information. Disaster preparedness, response, and coordination are a crucial piece of the larger resilience picture in densely populated urban areas.

Civil preparedness is required in order to increase the local, regional and national resilience for natural catastrophes and/or man-made disasters. Strategic approaches and policy development, information and public campaigns, table top and field exercises, trainings, as well as the use of technology and digital applications, all of these are essential tools that bring added value in terms of risk perception among the population, said George Manea from the Romanian Department for Emergency Situations.

## Thessaloniki, Greece

Thessaloniki has a rich history as a major hub of business and culture, from the Roman period to the Byzantine Empire. In its 2,300 years of history, the city has been part of the Hellenistic, Roman, Byzantine, and Ottoman empires. It has a significant Jewish history and experienced significant population shifts in the last century. The city's cultural and creative sector and its growing tourism draw from this multicultural history. Today it is still an important metropolitan region for Greece, with an active port and a respected university in addition to a robust tourist industry.

The city, however, has also been affected by the economic and political crises that have rocked Greece in recent years. Growing unemployment from a shrinking manufacturing sector and a lack of opportunities for young people have increased social needs, while resources to provide services have decreased. Tensions have led to the rise of extremism, riots, and civil unrest, and broken down relations between residents and public authorities. With new projects to upgrade infrastructure, officials see an opportunity to build trust and engagement with community members by involving them in planning processes. They are also using this approach to build response plans to

Figure 18: The six objectives of the Thessaloniki Waterfront vision.

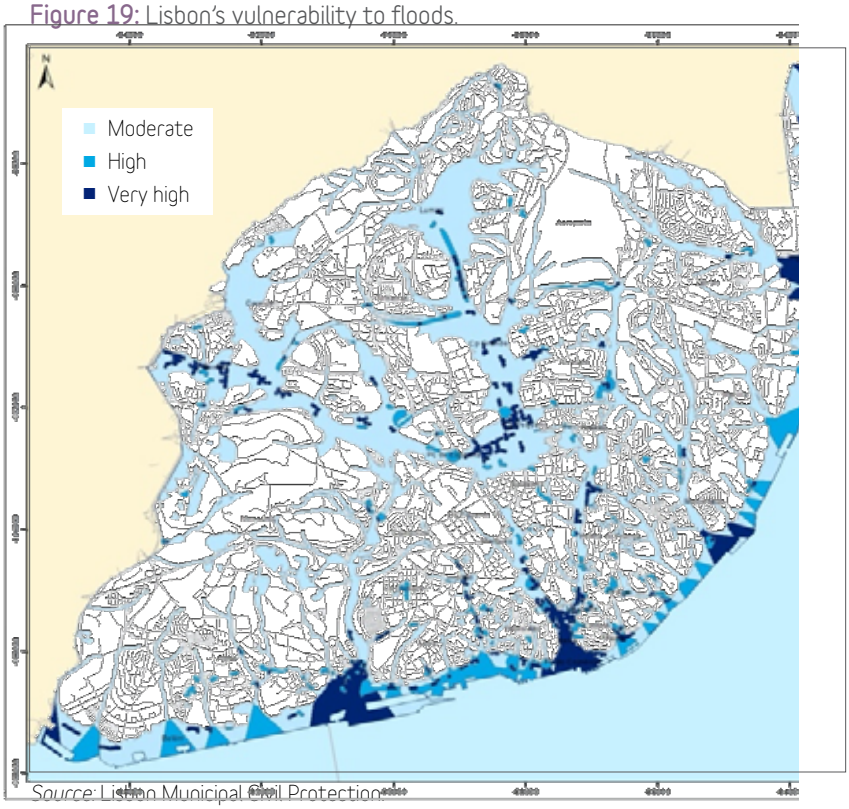

*Source:* City of Thessaloniki.

earthquakes and other natural disasters, as well as engage new youth networks in resilience planning.

The city launched "Thessaloniki 2030," the first city resilience strategy in Greece, in March 2017 (with support from 100 Resilient Cities), and it is now making good progress in the implementation of the strategy. The resilience strategy reflects Thessaloniki's ambitions as a city: *It wants to be inclusive; locally oriented but with international partnerships and exchanges; and forward looking to address interrelated challenges, goals, targets and actions.* As Greece has a highly centralized governance system, the city is seeking more financing and is exploring cross-sector partnership models to bring more resources to climate adaptation, sustainability, and resilience projects.

A major long-term revitalization project to create vibrant thematic destinations has been started along the city's entire 8.5 km waterfront (Figure 18). The project combines leisure and sports activities with commerce, while also linking the city with parks, green areas, bikeways, and pedestrian paths. Developing the city's most popular public space and creating more open and green spaces in the dense urban environment is a pressing issue. Thessaloniki's resilience strategy provides a roadmap for the city to make such revitalization projects happen, from concept to financing and implementation, in part by establishing the clear regulations that will encourage private companies to invest and also help communities trust that the public goals will be achieved.

Figure 19: Lisbon's vulnerability to floods.




*Source:* Lisbon Municipal Civil Protection

## Lisbon, Portugal

Lisbon, Western Europe's oldest city, is a major economic center for both Portugal and the rest of the continent. However, many of the city's buildings are centuries old, and infrastructure is likewise aging. Though the city has strong technical expertise and political will to undertake upgrades, it also faces financial constraints stemming from the global economic crisis. Urban improvement projects will be required to ensure residents have ongoing access to services, and to reduce the risk from seismic activity, which could cripple current structures and networks. The city is preparing for other threats—especially storms—by integrating response services to increase efficiency and effectiveness.

The challenges posed by climate change (based on projections up to 2100) include four main scenarios for the city of Lisbon: a rise in mean sea level, an increase in temperature, a decrease in rainfall, and an increase in extreme weather events. Given the last scenario—for example, an increase in the frequency and severity of extreme weather situations such as urban flash floods, combined with a maximum high tide, storm surge, and rising sea level—investment in a joint preventive policy based on a sustainable approach to minimize expected impacts is urgent. The city's resilience strategy therefore focuses strongly on urban flood risk (Figure 19) and prioritizes investment in planning, "building back better" adaptation and mitigation strategies, and reducing impacts and likely damage.

Floods in Lisbon are unpredictable events that can occur in less than

one hour due to heavy rain (flash floods with overload of drainage systems), or during long periods of rainfall (floods with rising water levels). To assess the main flood risk areas, the municipality used spatial analysis tools to combine physical and socio-urban variables with historical flooding situations identified by the emergency services. The implementation of the strategy has seen the adoption of some innovative cross-sector work within the municipal government, including preventive drain cleaning, transformation of open spaces with permeable surfaces, and deepening of solutions to the main rainwater drainage problems with the construction of two large tunnels (5 km and 1 km) and other infrastructure, in order to mitigate the consequences.

## Challenges

From the presentations and during the panel discussion, a number of key challenges facing cities that aim to build greater resilience emerged. These include

- Short political cycles, relevant to the timelines for resilience planning and responses, which make it difficult to know if longer-term initiatives will be seen to conclusion
- Conveying the urgency of resilience investments and securing support for them within environments with limited financial resources and many competing investment needs
- Stability and capacity within city administration that often lacks crucial technical expertise, which may hamper planning and implementation of more complex infrastructure projects
- Ensuring that actions occur and decisions are made along a very long chain of activities for resilience interventions (from planning to implementation and response), especially around the most pressing areas for action

## Recommendations and Conclusion

While city officials and leaders face complex and ever evolving challenges, there are some key lessons from this session that show that it is possible to make positive strides toward resilience:

- **Rely on data-driven decision making and robust analytics.** Utilizing multi-layered analysis and GIS tools can not only allow for improved insights and problem diagnosis but can also be used to build support for larger-scale and more ambitious investment projects.
- **Secure community participation and buy-in for interventions.** Infrastructure investments needed to improve resilience may at times inconvenience residents and require trade-offs in local budgets. Community capacity building and active participatory processes can help to build both support for investments and ensure future use of community assets.
- **Seek efficiency gains through cross-cutting approaches.** Many solutions to improved city resilience are found not in major infrastructure investments, but in working better across silos within city governments or across spheres of government. Simple actions such as increasing the frequency of cleaning of stormwater drains could significantly reduce flooding. This approach requires improvements in the flow of information and communication between various departments and ministries.

The final key message is that every city's environment and most pressing issues are unique, and thus solutions, investments, and pathways for development must be highly tailored to address those local needs. There is no one-size-fits-all solution to urban resilience, but there are many examples (including the cases presented in this session) that lessons can be learned from.

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# Critical infrastructure risks and why investing in resilience makes financial sense

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## Session Summary

This session made the case that investing in resilient infrastructure can unlock significant economic opportunities for people. An expert panel discussed practical steps that can be taken to ensure the resilience of infrastructure systems, and ways to overcome the institutional and financing barriers that often impede progress. The session was based on the World Bank's recent *Lifelines* report (Hallegatte, Rentschler, and Rozenberg 2019), which showed that investing in resilient infrastructure is a significant economic opportunity: the overall net benefit of doing so in developing countries would be $4.2 trillion over the lifetime of new infrastructure, with $4 in benefits for each $1 invested. The panel members contributed hands-on perspectives on how to increase infrastructure resilience, with case studies from the European Union, Romania in particular, as well as global examples from Indonesia and Nepal. Key messages include the following: First, there is a direct link between resilient infrastructure and development outcomes. Second, there is a strong economic case for investing in resilient infrastructure. Third, a roadmap for ensuring infrastructure resilience includes better maintenance, but also targeted actions for risk-informed decision making and financing.

Photo: chameleonseye.

## Background

There is a direct link between resilient infrastructure and development outcomes. Especially in developing countries, infrastructure disruptions are an everyday concern. Not only do they affect people's well-being and quality of life, but they also undermine businesses, job creation, and economic prospects. Resilient infrastructure, on the other hand, can be a lifeline to better health, better education, and better livelihoods. Natural hazards cause significant damages to infrastructure assets. In low- and middle-income countries, direct damages to power generation and transport infrastructure amount to $18 billion a year. Yet when natural hazards damage and disrupt infrastructure, the main impacts are not the repair costs borne by the road agency or power utility. Instead, the main impact is on people: on businesses that lack the electricity to keep factories running or use the internet to process orders and payments; and households who lose access to safe drinking water or are unable to go to work, to school, or to hospitals.

Altogether, infrastructure disruptions caused by natural hazards, poor maintenance, and mismanagement of infrastructure are costing households and firms at least $390 billion a year in low- and middle-income countries. While this figure is large, it does not cover some important effects that are difficult to measure. For instance, the impact on gender equality is crucial, as girls' access to education is particularly affected by unreliable power supply. Substandard sanitation and floods exacerbate water-borne diseases that particularly affect children. And the cost of electric generators reduces the ability of small firm to innovate and compete. Not all infrastructure disruptions are due to natural hazards and climate change. But storms, floods, earthquakes, and other natural hazards are still responsible for between 10 and 70 percent of all disruptions, depending on the country and sector. Moreover, infrastructure systems that perform poorly under normal conditions are particularly vulnerable to natural shocks.

## Case Studies

There is a strong economic case for investing in resilient infrastructure. Solutions to improve the resilience of infrastructure systems are readily available. Investing in these solutions is both sound and profitable. A range of options exists to make infrastructure assets more resilient, such as reinforcing electric poles and elevating roads. However, it is critical to go beyond individual assets, and adopt various approaches to designing more resilient systems and networks:

- **Network redundancy.** It can be more efficient to build redundancy into networks by increasing the number of connections; a city that is accessible through multiple roads and powered through multiple transmission lines is less likely to find itself isolated or without power.
- **Criticality analysis.** Identifying and prioritizing the most critical components of infrastructure systems can help to strengthen weak or vulnerable links and build resilience at the lowest possible cost.
- **Nature-based solutions.** Conserving forests to prevent landslides, or wetlands to improve water quality, is often more cost-effective than relying on hard infrastructure alone.

Still, not all infrastructure disruptions can be prevented, which means that it is essential to prepare for and manage them—for instance by ensuring that each home has emergency supplies, that firms have robust and adaptable supply chains, and that critical users like hospitals have backup capacities.

The overall net benefit of investing in resilient infrastructure in developing countries would be $4.2 trillion over the lifetime of new infrastructure. The returns on these investments depend on many factors and are very context specific. Nevertheless, investing in more resilient infrastructure is profitable in almost all conceivable scenarios. Indeed, estimates show that, on average, $1 invested in these solutions yields $4 in benefits. Moreover, the extra cost of ensuring that all new power, water, sanitation, and transport infrastructure assets are resilient is only 3 percent of overall investment needs. Climate change and the rapid pace of infrastructure development make it even more important and urgent to integrate resilience in all

infrastructure investments. Each decade of inaction costs low- and middle-income countries around $1 trillion in losses.

A roadmap for ensuring infrastructure resilience includes better maintenance, but also targeted actions for risk-informed decision making and financing. For infrastructure investors, governments, development banks, and the private sector, the message is clear: rather than just spending more, spend better. Closing the infrastructure gap to meet the Sustainable Development Goals will require substantial investments in new infrastructure and in the maintenance of existing assets. But again, it's not only about spending more, it's also about spending better.

Investing in smarter planning, regulation, project design, and maintenance can significantly reduce the costs of repairs or reconstruction after a disaster strikes. The following areas of focus are key:

- **Maintenance.** Preventive maintenance reduces the overall cost of infrastructure, and improves its efficiency, reliability, and resilience.
- **Early stage project design.** Too often, early stage project design lacks the resources to perform adequate risk assessments and to identify cost-effective solutions—even for multi-billion-dollar projects. This trend should be reversed.
- **Standards and capacity building.** Resources must also be targeted toward improving construction standards and building norms: the enforcement capacity of regulatory agencies should be strengthened; master plans should account for natural risks, reinforce redundancy, and build on nature-based solutions; and data on natural hazards, climate change scenarios, and modeling tools should be freely available so that decision makers can account for natural risks.

Small investments at the early stages of project design can be transformational and highly cost-effective. However, as they often lack funding in low-income countries, there is an important role to play for the international community.

## Recommendations and Conclusion

Based on the Lifelines report, the session set out five detailed recommendations to ensure that infrastructure systems and users become more resilient:

1. **Get the basics right.** Ensure that infrastructure assets are well designed and maintained.
2. **Build institutions for resilience.** Coordinate the actions of the many stakeholders involved in infrastructure design and operations.
3. **Create regulations and incentives for resilience.** Ensure that all actors take into account the full cost of infrastructure disruptions to people and firms.
4. **Improve decision making.** Strengthen decision-making capacities and provide appropriate data on natural hazards and climate change.
5. **Provide financing.** Focus on early stage funding for resilient infrastructure design to save large amounts over the asset's entire lifetime.

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**Investing in more resilient infrastructure is profitable in almost all conceivable scenarios. Indeed, estimates show that, on average, $1 invested in these solutions yields $4 in benefits.**

# Innovations in geospatial data collection and analytics: Shaping the future of understanding the built environment

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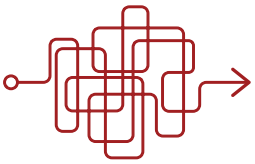
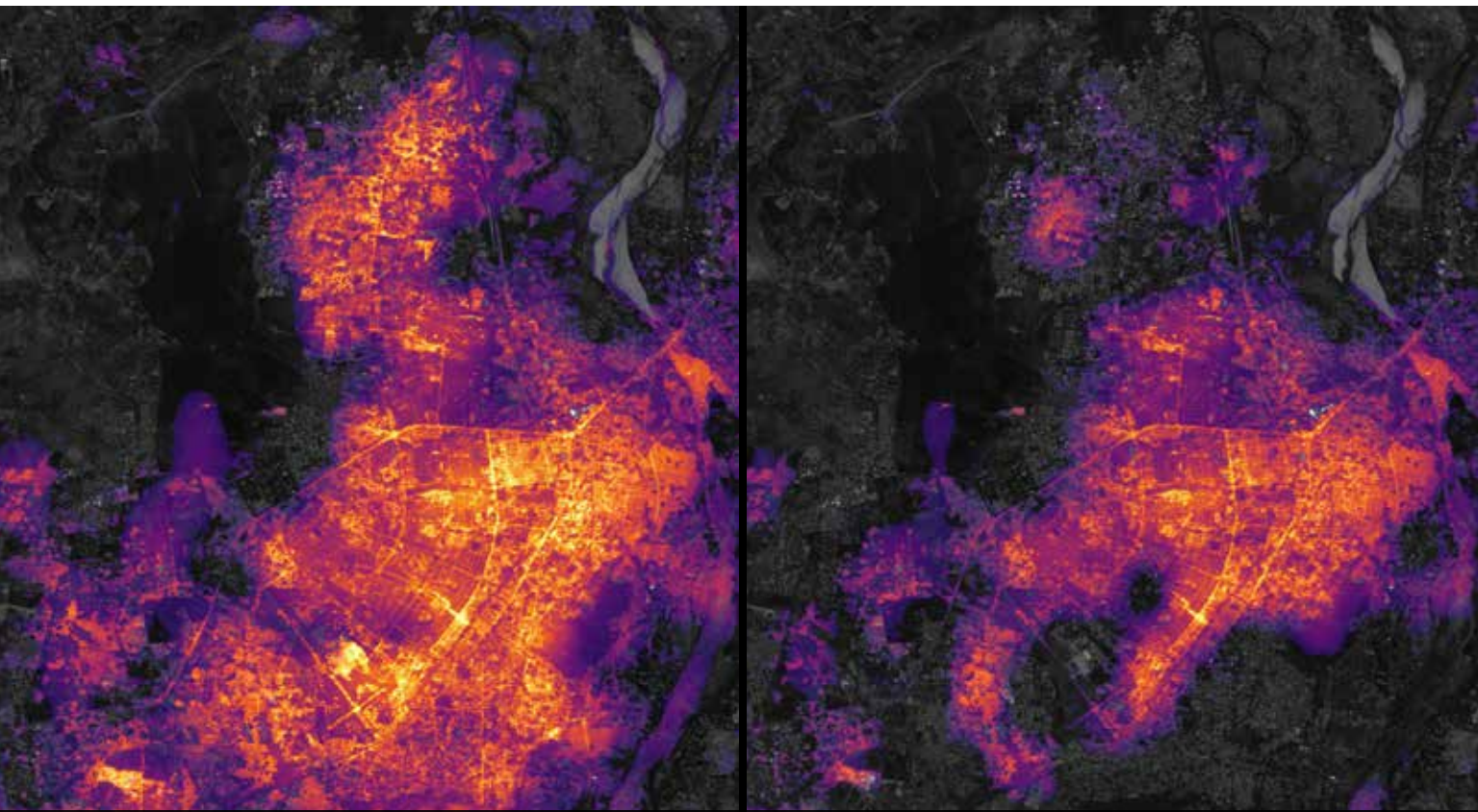
## Session Summary

When a disaster strikes, having immediate insights into who and what are affected is critically important. When a large area has been affected, eyewitness reports or photos can provide an important snapshot, while satellite imagery can show in one single image the full extent of the disaster. Understanding the big picture is important, but for satellite imagery to make a real difference for first responders, the imagery needs to be actionable. This means it needs to be granular and in near-real time. This raises an important question: can analytics based on satellite imagery directly inform decision making?



**Understanding the big picture is important, but for satellite imagery to make a real difference for first responders, the imagery needs to be actionable.**





Beira, Mozambique. Before and after Tropical Cyclone Idai. An estimated 1 million people were without electricity. *Source:* NASA.

## Background: Satellites, Cloud Computing, and Artificial Intelligence

Satellites have been around for a while, but over the past decade the number of satellites in orbit has increased exponentially. These satellites are producing an enormous amount of data. In fact, satellites are producing so much data that it has become more than humans can handle. In the past, this would have been a challenge, since only governments had the ability to do large-data computation, but today there are numerous cloud computing applications for the general user. Building on these advances, new opportunities are emerging that combine satellite imagery and cloud computing with computer vision and deep learning.

Within computer vision and deep learning, object detection is a promising technique. This technique makes it possible to automate the identification and location of objects of a certain class in an image. For example, Microsoft applied this technique to predict building footprints of 120 million buildings across the United States, and scientists at Planet used object detection to identify every single road on earth. While the outcome may not be 100 percent accurate, this automated approach does offer an unprecedented level of global completeness. Change detection is another promising technique; it enables the identification of spatial changes in satellite images over time, which if done manually can be time-consuming and tedious. An automated approach allows this type of analytics to be done fast and at scale.

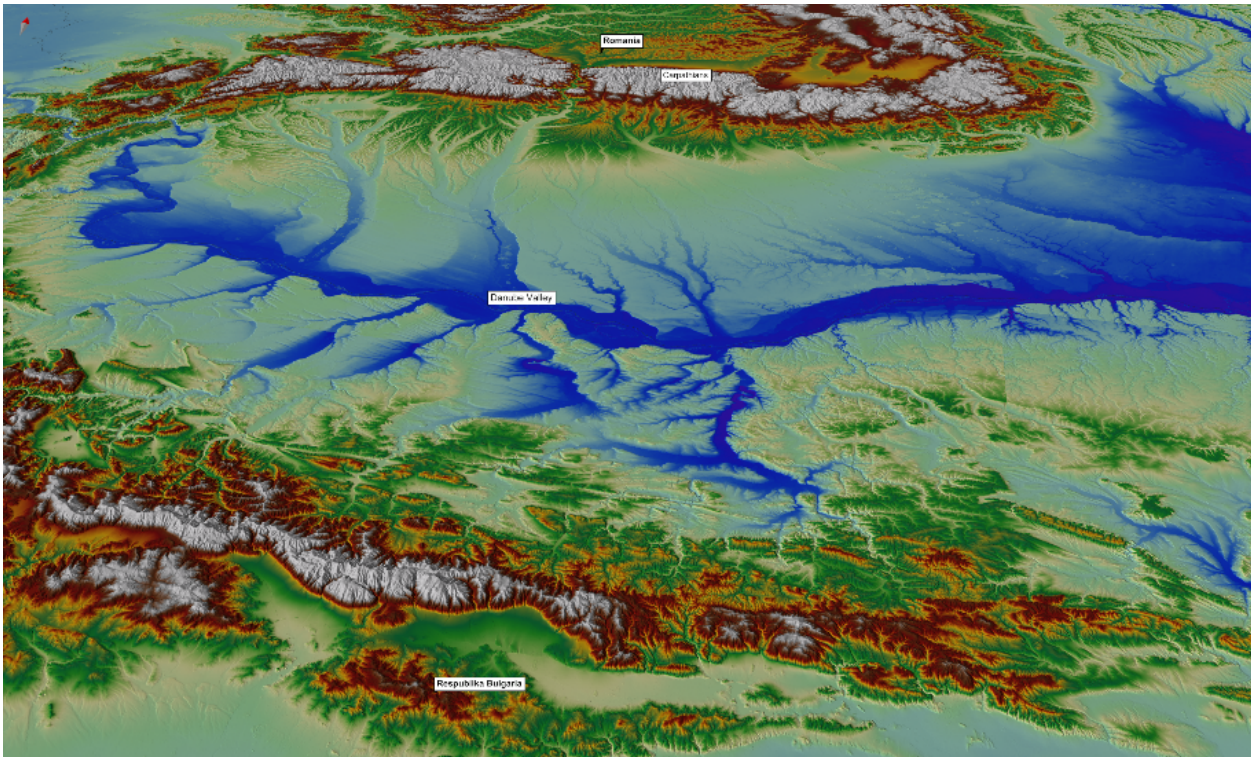
How can computer vision and deep learning inform decision making before and after disasters? In the aftermath of a disaster, satellite imagery can provide a bird's-eye view of the affected area. In the case of a flood event, the imagery shows the extent of flooding, but it does not answer simple but critical questions, such as how many buildings and roads are flooded, or which roads are obstructed or impassible. Computer vision and deep learning, however, can analyze the satellite imagery to answer these questions. Automated object and change detection can be used to identify the entire road network and determine which roads are affected during the flood event.

Computer vision and deep learning can also provide value before disasters strike. Satellite imagery can provide insights into the number of people and assets concentrated in high-risk areas. This allows decision makers to understand who and what are potentially in harm's way today. Computer vision and deep learning can build on this and show who and what are likely to be in harm's way in the future. In the case of floods, one can look at the rate of new construction in high-risk areas, such as floodplains.

**Figure 20:** Roads and buildings in rural area northeast of Vientiane, Lao People's Democratic Republic.

*Source:* Planet Mosaics team/Planet Analytics team/OpenStreetMap and its contributors.

**Figure 21:** 5 m Euro-Maps 3D digital surface model of the river Mariza at the Greek-Turkish border.




*Source:* Andreas Uttenthaler, GAF.

Rather than having to rely on an inspection agency, which is often understaffed, decision makers can use automated change detection to provide immediate insights into where the level of exposure is increasing and to quantify the level of change (see Figure 20).

This session showcased ongoing efforts by GAF, Stanford University, and Orbital Insights to apply the latest developments related to satellite imagery, cloud computing, computer vision, and deep learning to inform decision making before and after disasters.

## Case Studies

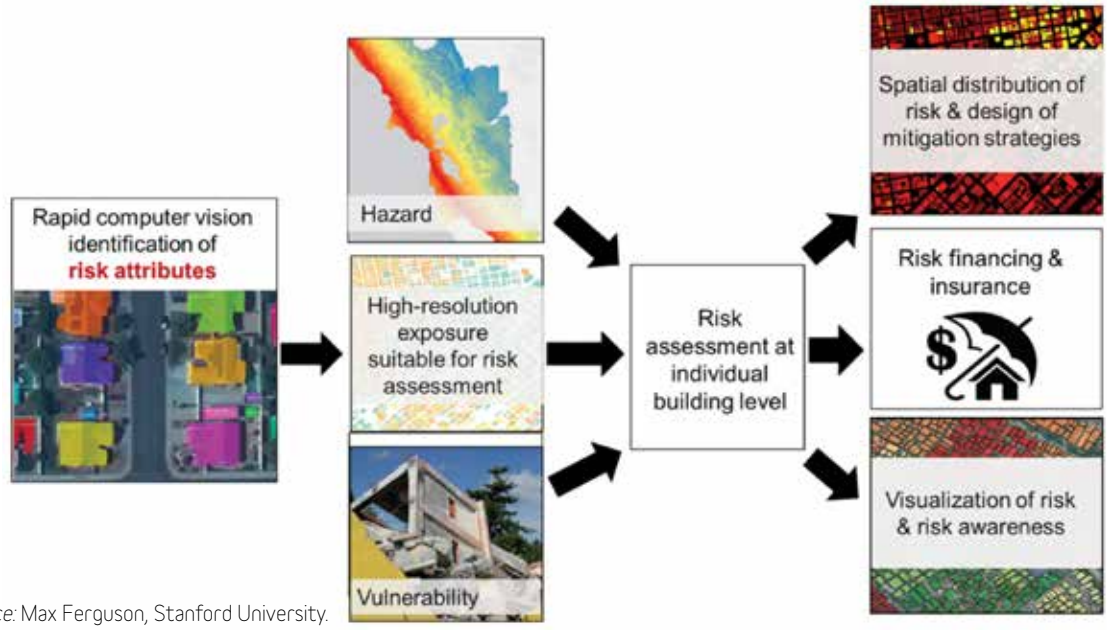
### Case study 1: The development of digital elevation models based on optical stereo and multi-stereo satellite imagery

Several trends—the constantly increasing availability of very high-resolution (VHR) and high-resolution (HR) satellite imagery; recent developments in data resolution, quality, and collection capabilities; and advances in computer vision—have made it easier to produce highly accurate digital elevation models and different types of maps. Optical stereo and multi-stereo satellite images are therefore a valuable source for the worldwide and standardized generation of digital surface models (DSMs), digital terrain models (DTMs), and other derived products (e.g., building footprints). These are important basis layers for many geospatial applications in the risk management domain, such as flood risk modeling, vulnerability mapping, damage assessment, and population estimation.

In the last 10 years, in close cooperation with the Remote Sensing Technology Institute (IMF) of the German Aerospace Center (DLR), GAF has developed a highly automated multi-source production line for generating digital elevation models out of optical stereo and multi-stereo satellite data. This production line is based upon a pixel-wise matching approach called Semi-Global Matching (SGM), and currently more than 180 cities worldwide have been processed as either 30 cm or 50 cm DSMs, and more than 8 million km$^2$ have been processed as 5 m DSMs. The 5 m Euro-Maps 3D DSM is already available for the whole of Europe and can be used for transnational applications.

The automated processing chain can be easily adapted to new satellite input data,

**Figure 22:** Risk assessment with computer vision.




*Source:* Max Ferguson, Stanford University.

and processing capacities can be further increased by using either a scalable private cloud infrastructure or public clouds for the stereo matching process, which leads to an accelerated production. During the session, GAF presented examples with a focus on southeastern Europe, where VHR and HR digital elevation models and derived products have already been generated on a large scale (see Figure 21). The same approach can also be used by cities to support urban planning and disaster risk and emergency management.

### Case study 2: Computer vision–powered risk analytics for cities around the world

To answer critical questions about cities' exposure to disaster risk at scale, we turn to a combination of AI-based technology and proven expert analytics. The idea is simple: use emerging technologies to rapidly collect exposure data from satellite imagery. In the case of earthquake risk, the system predicts building characteristics, such as the building material, building height, building footprint, and the seismic code that was used for construction. Just a few years ago, this technology would have been considered unfeasible, demanding resources that most countries and communities did not have. However, with recent developments in computer vision and the increased availability of satellite imagery, it is now possible to automate a large portion of this work.

## Recommendations and Conclusion

The potential to conduct rapid high-resolution risk assessments using satellite imagery and state-of-the-art risk analytics opens up opportunities for cities around the world to understand their risks and begin taking proactive steps toward enhancing disaster resilience (Figure 22). This is particularly relevant for developing countries, which often operate under severe data constraints and have scarce financial resources for disaster risk mitigation, and where development efforts are unfortunately threatened by the economic burden of disasters. Computer vision technology can help cities overcome the lack of data and prohibitive prices for data collection, leading to a better understanding of risk and enabling data-driven disaster risk management practices. We are currently taking the next step toward the ambitious goal of creating a worldwide information system of the built environment and deploying the technology to perform high-resolution mapping of residential buildings in 29 cities across Europe and Central Asia.

# Assessing and managing risk to cultural heritage: Preserving the past for the future

Session Contributors

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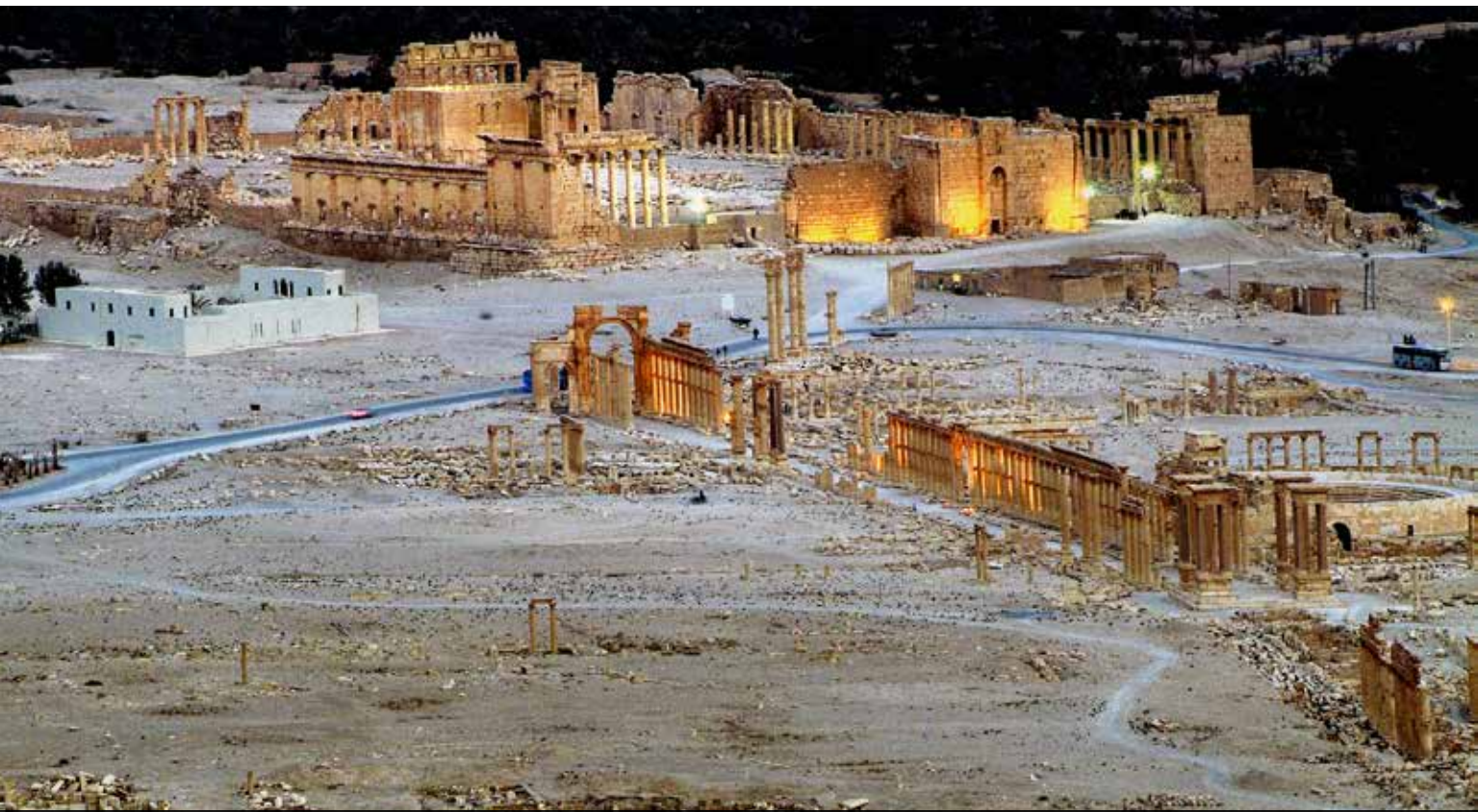
## Session Summary

There is a growing, overarching consensus today that cultural heritage conservation and preservation are an integral part of building resilience. However, even as advances are made in the methods and tools to better protect physical heritage and assets, the preservation of intangible social and communal heritage as an integral part of the post-disaster reconstruction process remains poorly understood. In this context, this session sought to showcase the ways in which the devastating impacts of natural disasters can affect the cultures of communities, and it discussed the many benefits of including a targeted approach within disaster risk management (DRM) for tangible and intangible forms of cultural heritage alike. The session also sought to shed light on some of the emerging innovative solutions and tools available to improve the current understanding of disaster risks in the context of cultural heritage, and to show how such information could be useful during all DRM phases.



 Palmyra, Siria. Photo: diatrezor.

## Background

Cultural heritage can be highly vulnerable to natural disasters and climate change due to greater exposure and aging structures. The recent earthquakes in Albania (2019) and Turkey (2020) not only caused devastating losses to human lives, but also led to irreparable damages to built environments and other infrastructure, including potentially irreplaceable cultural heritage assets. In Albania, for example, two national museums are now considered uninhabitable, and approximately 53 monuments received some form of damage from the earthquake. These recent cases illustrate the potent threat that natural hazards can pose to historic heritage sites, over and above the inherent complexity that arises from the unique characteristics of each asset, i.e., whether it is tangible or intangible, movable or immovable, or some combination of the aforementioned.

According to UNESCO (United Nations Educational, Scientific and Cultural Organization), cultural heritage is both the physical and intangible attributes inherited from the past that help define a society. Cultural heritage goes beyond physical assets, monuments, and museums and spans people's traditions, cultures, and identities. In this regard, it is imperative to find methods to prevent or reduce the impacts of disaster events that can cause irreparable damage to the social and economic fabric of local communities and livelihoods. The case studies presented during the session highlighted these very issues, particularly with regard to how to communicate the risks and help both decision makers and practitioners understand the intrinsic value that culture has. Given that culture is not homogenous and varies across countries, this makes developing generic solutions and proposals within the DRM practice even more challenging.

## Case Studies

**Xavier Gerard** underlined the potential of new, modern technologies to support digitization of endangered heritage sites around the world and thus record them for future generations. He showed how 3D scanning techniques, including by means of drones, have been used in more than 30-plus countries to digitize iconic heritage sites, including Saint Jacques Tower in France, Pompeii in Italy, Island of Delos in Greece, Mes Aynak in Afghanistan, Palmyra in Syria, and Angkor in Cambodia, to name a few. Importantly, the presentation also described work undertaken in Syria and Iraq to highlight how these new technologies are useful for recovery of cultural heritage in emergency situations and support the recovery of people impacted by conflict or disaster.

**Zeynep Gül Unal** showcased inspiring stories of post-disaster recovery of cultural heritage by professionals and local communities in Nepal, Mali, Pakistan, Turkey, and Brazil. Through the documentary series *ICOMOS-ICORP On The Road Project*, case-study stories highlighted the impacts that disasters have on both the economy and social fabric of the local communities affected by the destruction of their cultural heritage. She highlighted in particular the role of traditional knowledge in reconstruction as well as the opportunities provided by reconstruction to revive traditional knowledge that may have been lost in the past.

**Matei Sumbascu** and **Raluca-Maria Trifa** showcased efforts in Romania to engage communities in historical neighborhoods of Bucharest to better prepare for the next disaster and safeguard the rich cultural heritage for the next generation. Their presentation highlighted the challenges facing the built heritage of Bucharest, where a large number of cultural heritage assets are currently in an advanced state of degradation due to lack of maintenance, abandonment, uncertain legal status, etc. In addition, their presentations illustrated the challenges involved in helping communities in at-risk areas better understand the risks they face and take action to preserve their heritage. To address this challenge, the Catalog Bucuresti project is undertaking an extensive effort to collect and analyze all the buildings located in the Built Protected Areas of Bucharest. This community-oriented seismic preparedness project is helping to educate and raise awareness among the inhabitants on ways to support the preservation of the built heritage in historical neighborhoods of Bucharest.

**Luca Ponticelli** presented the experience of the Italian Task Force for the safeguarding of cultural heritage in emergencies and described how quick response is imperative to avoid irreplaceable losses. Italy has the greatest number of UNESCO World Heritage

Sites and has suffered from recurrent earthquakes throughout its history. He shared experiences of rescuing cultural heritage assets following the earthquakes in 2009 in L'Aquila (Italy), Nepal (2015), and Antigua and Barbuda (2017), emphasizing in particular the physical measures adopted to protect the assets, remote assessment and processing tools used, and procedures adopted to prevent further degradation.

## Challenges

The session identified several main challenges:

- The risk to cultural heritage continues to increase in the face of climate change, growth and development, and other factors. As a result, there is a need to continue to invest in risk identification tools and methods, and at higher resolutions, that help catalog and communicate the likely future impacts of natural and man-made disaster events on cultural heritage sites. This effort entails careful documentation of cultural heritage assets and local traditions, including through digital media, online platforms, smartphone applications, virtual museums, and social media platforms, and using this information to increase public awareness of the risks and what can be done to preserve heritage assets.
- There is a strong need to foster the preservation of culture within vulnerable communities, as safeguarding culture strengthens resilience and promotes cohesion. Communities themselves often have traditional knowledge that indicates how best to protect their cultural heritage, but they often lack adequate resources. By working closely with knowledgeable community members, conservation efforts can also be a powerful tool to build broader resilience across communities.
- In many countries, there is still no functional coordination mechanism between the DRM and cultural heritage preservation fields. In order to have a complete understanding of the risks heritage sites face, it is essential as a first step that professionals and agencies in DRM and cultural preservation engage in cooperative work to arrive at complete solutions.
- Cultural heritage is still not fully integrated in most national disaster risk management strategies. While the Sendai Framework includes among its key priorities the preservation and protection of cultural heritage, many national entities have yet to adequately address the potential cultural heritage impacts in their emergency plans and do not have dedicated contingency plans to protect vulnerable cultural heritage.

## Recommendations and Conclusion

To preserve the past, the first step is to see the safeguarding of cultural heritage as a core component of DRM policies and planning. This means integrating cultural heritage protection into public awareness campaigns; national, subnational, and local disaster risk reduction plans; land use planning; and other facets of disaster risk management across all levels. Some other important steps include the following:

- Conducting data collection, cataloging, and assessment of risks to cultural heritage sites in a manner that is easy to understand and produces actionable information for all relevant actors, such as site managers of cultural heritage assets, local communities, and emergency responders.
- Exploring and encouraging further use of innovative tools, such as 3D modeling for digitization of cultural heritage assets, prior to disaster events, along with use of artificial intelligence following disasters to support reconstruction efforts.
- Improving the urban legislation regarding cultural heritage to better protect built heritage and support the resilience of the communities that inhabit those areas. This step should include dedicated public awareness efforts from officials to ensure that communities are better prepared for disasters.
- Promoting better communication of risks and collaboration between disaster risk managers and cultural heritage entities, both within countries and across state borders. Early warnings and close work with DRM professionals to better prepare for disasters will

allow heritage managers to protect sites, communities to prepare for likely scenarios, and policy makers to prioritize investments in risk management.

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**To preserve the past, the first step is to see the safeguarding of cultural heritage as a core component of DRM policies and planning.**

Island of Delos, Greece. Photo: onepony.

# Assessing and managing the threat of emerging risks (cyber threats, pandemics, extreme heat)

Session Contributors

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**Bogdan Carlescu,** Bitdefender, Romania

## Session Summary

Earthquakes, hurricanes, and even the worst terrorist attacks are localized events. Emerging risks—such as epidemics, cyber threats, or extreme heat—don't follow the classical definition of a disaster. They may occur over months. They are not confined to one place. They are unlikely to progress in an easily predictable way. These have been historically the "uninsurable" risks, due to the nature of the damage—not instantaneous shocks, with immediately measurable effects, but rather longer-term shocks, with systemic risk ramifications in various industries.

The common traits that emerging risks share are first that they are occurring more frequently, and second that they are facilitated by high levels of interconnectivity and population mobility. Pandemics and extreme heat also have in common that they are visible effects of climate change.

When will it happen? (Anticipation)
How bad will it be?
For how long will it last?

Korea, January 28, 2020. At the main entrance of Incheon St. Mary's Hospital, hospital staff check the outbound records of outpatients and visitors to prevent the entry of new coronaviruses. Photo: Goldcastle7.

## Background

Industries have unique financial and operational risk profiles, but the general lack of thorough business interruption or contingency planning leaves most companies vulnerable to emerging risks, without financial recourse. Today's improving data technologies, and the robust models they are enabling, should allow business and political decision makers to be better informed about these risks. The better they understand them, the better their chances of mitigating and containing losses.

Experts from the various fields have shared knowledge on the latest advancements and real applications of their work in measuring and preparing against these "atypical" catastrophes. Both livelihoods and lives will depend on the energy and resources businesses and governments apply to what is less a possibility than a likelihood.

## Case Studies

### How extreme heat threatens our cities and livelihoods

Although not as immediately obvious as the effects of floods or storms, extreme heat such as is experienced during heat waves is a direct threat to society, with effects ranging from increasing risk of blackouts in the power supply chain to serious health effects and even death. The United Nations Environment Program stated that the 2003 European heat wave was the worst natural disaster in the last 50 years in Europe, claiming over 30,000 casualties.

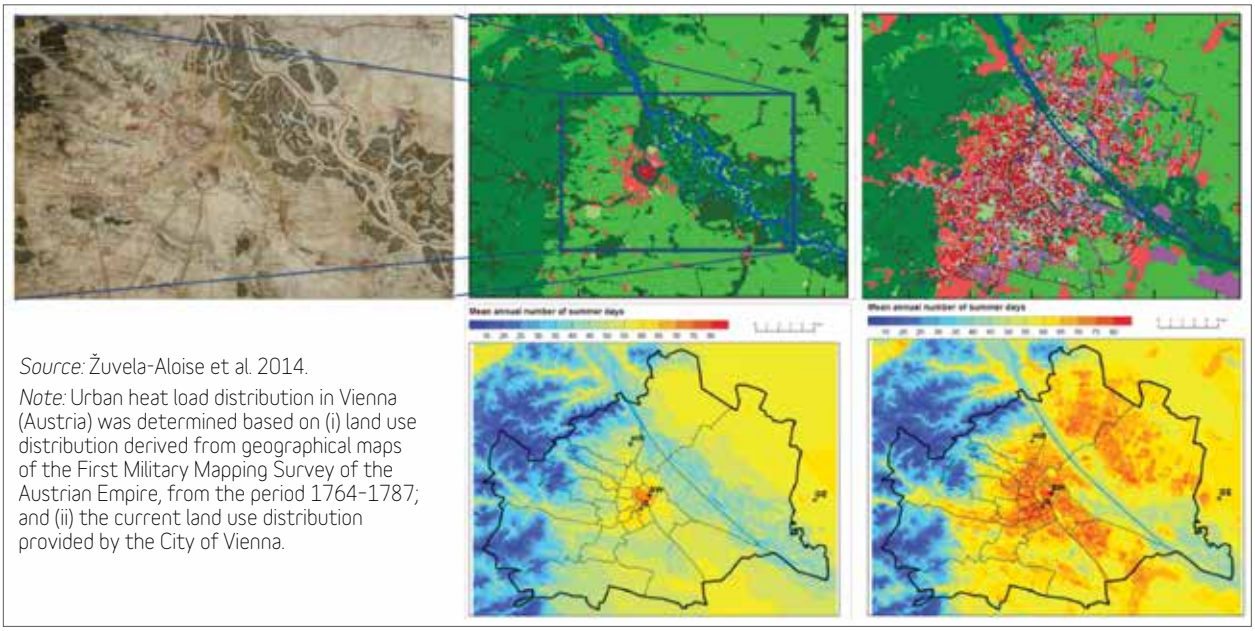
As a result of climate change, heat waves continue to increase in duration, frequency, and intensity. Cities are particularly vulnerable, as urban areas are generally warmer than their surroundings, an effect referred to as the Urban Heat Island (UHI). Urban surfaces, such as buildings, roads, and parking lots, absorb more heat than the rural areas surrounding the city, and less evaporative cooling takes place in cities because the amount of vegetation is lower. Currently, over 70 percent of the European population lives in urban areas, causing a high number of people to be exposed to these increased temperatures.

Heat load distribution in several Central European cities, including Vienna (Figure 23) and Krakow (Figure 24), clearly shows how increased urbanization is contributing to heat island development.

### Pandemics: Deadly, costly, and increasingly frequent threats

Every flu season, public health experts speculate about the likelihood of a future global pandemic and its possible costs to lives and livelihoods. No one doubts those costs will be high. In recent years, outbreaks of highly infectious diseases, though short of pandemic levels, have taken billions of dollars

Figure 23: Reconstructing urban climate of Vienna based on historical maps.



*Source:* Žuvela-Aloise et al. 2014.

*Note:* Urban heat load distribution in Vienna (Austria) was determined based on (i) land use distribution derived from geographical maps of the First Military Mapping Survey of the Austrian Empire, from the period 1764–1787; and (ii) the current land use distribution provided by the City of Vienna.

Figure 24: Urban climate in Krakow and global climate change. A clear increase in heat load is projected toward the middle of the century and strong increase toward the end of the century. *Source:* Bokwa et al. 2018.

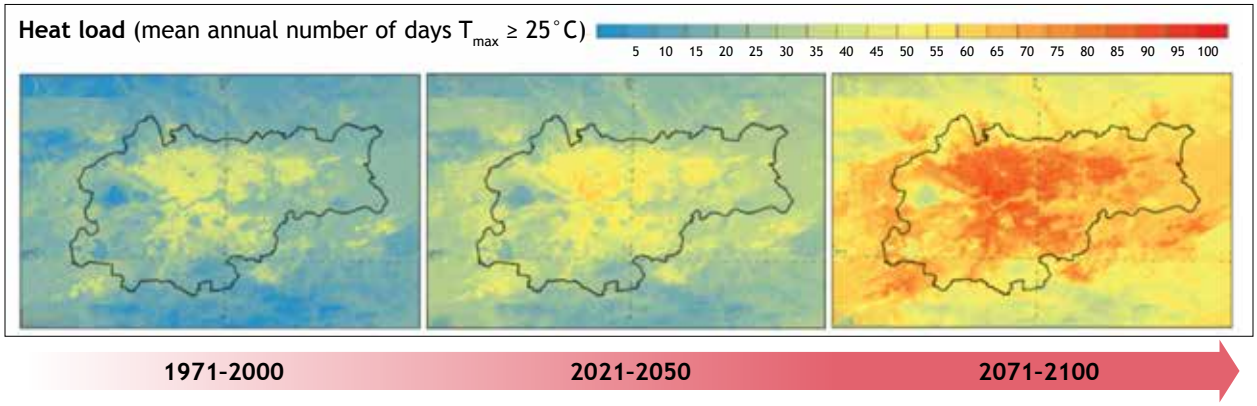
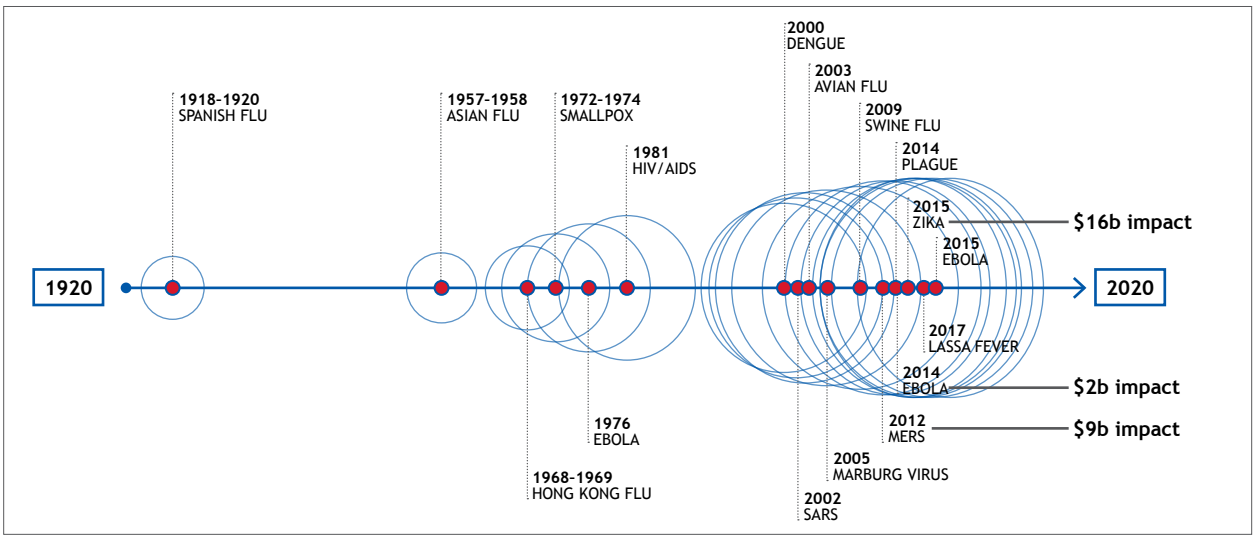



Figure 25: Last 100 years of epidemic outbreaks and their economic impacts.




*Source:* Metabiota.

from the global economy and caused untold misery. For example, the World Bank projected losses of $3.5 billion in Latin America and the Caribbean due to the 2016 Zika virus. The 2014 Ebola outbreak in Guinea, Liberia, and Sierra Leone cost those countries an estimated $2.8 billion in overall economic impact through 2015.

While public health officials and medical professionals work to understand how to prevent or contain pandemics to save lives, less attention has been paid to containing the economic risks. The report by the National Academy of Medicine's Commission on a Global Health Risk Framework for the Future ("The Neglected Dimension of Global Security. A Framework to Counter Infectious Disease Crises (2016)") estimates that an outbreak on the scale of the 1918 influenza pandemic would cost the global economy as much as $60 billion a year (Figure 25). Despite this and other frightening estimates, businesses today are unprepared for the revenue losses that would result from the disruption of commerce during a global or even a regional disease outbreak.

## Cyber risk

Cyber risk is a relatively young threat with a short history of insurance claims experience, which demonstrates that the risk is constantly changing and evolving. Media reports are full of individual cases of major data breaches or cyberattacks on high-profile technology targets. The main fear is that the cyber threat is inherently scalable—a single malicious email can reach

hundreds of thousands of company recipients with one click of a mouse. Cyber risk is clearly systemic, as it is spread through interconnectivity: the internet, communications, and internal and external networks. These connections are neither obvious nor easily tracked. In the same way, the motivations behind any cyberattack will vary depending on the initiating actor (Figure 26).

# Recommendations and Conclusion

## Extreme heat

Actions that help reduce the effects of urban heat islands range from single adaptation options to urban planning strategies and heat wave measures in cities. They provide concrete tools for city officials or policy makers to combat excess heat risks (Figure 27).

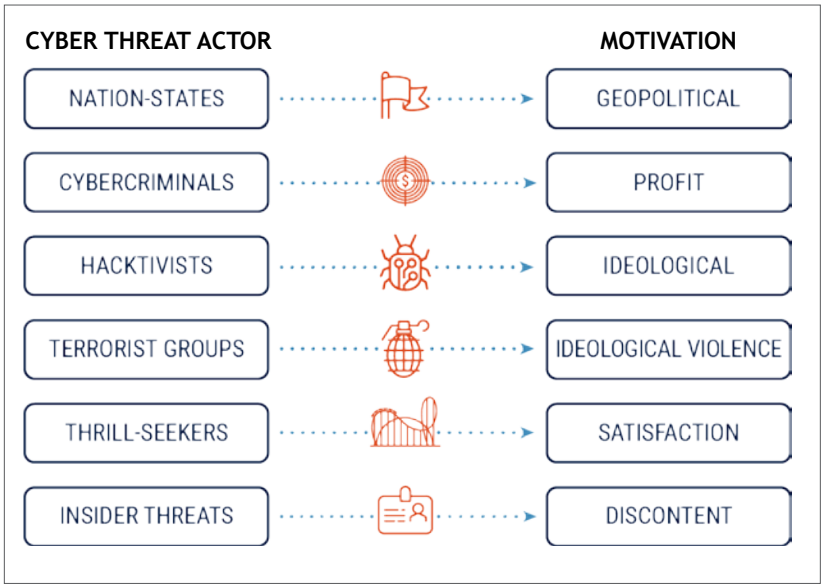
The strategic urban planning begins with city analysis reliant on versatile models that highlight "hot spots," predict the future heat load, and help screen for the optimal adaptation measures. The adaptation measures for climate-resilient urban planning imply the combination of various adaptation measures (Figure 28) to reach the optimal mix of small measures that ensure that responses to heat waves do not exacerbate the problem of climate change. The adaptation measures can be grouped by implementation options and expected outcome in Green, Blue, or White city approaches. For example, Green city strategies focus on parks, green roofs or vertical gardens for evaporative cooling and insolation, as well as energy savings and better storm water retention. Blue city strategies favor the creation of ponds, lakes, fountains or canals to achieve evaporative cooling and increased ventilation in cities. Finally, White city approaches suggest the use of bright (reflective) materials for a better reflection of solar radiation as well as energy savings.

## Preparedness for pandemics

Preparedness is a marathon, not a sprint. Decisions on funding for preparedness or response to epidemic risk must be framed by quantitative risk analytics. Quantified risk provides the analytical underpinning for decision making and can help in attempting to build a unified view of risk.

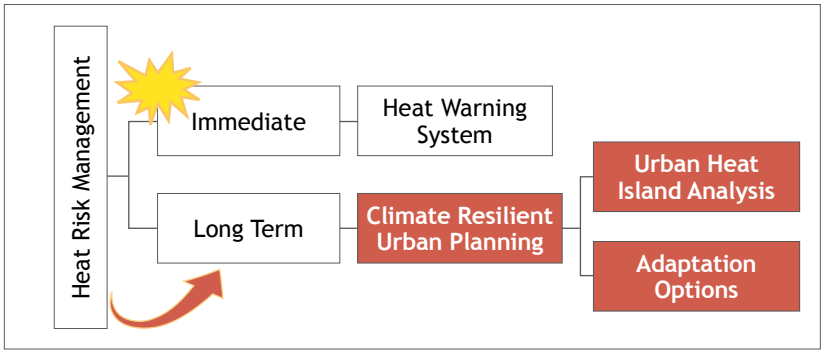
The solution starts with the creation of a market for more robust epidemiological models (which account for socio-demographic characteristics, transportation patterns, or hospital capacity) and better data (from epidemiological and public health research on disease spread) that can be combined to improve pandemic risk models, allowing

Figure 26: Type of cyberattack by initiating actor.



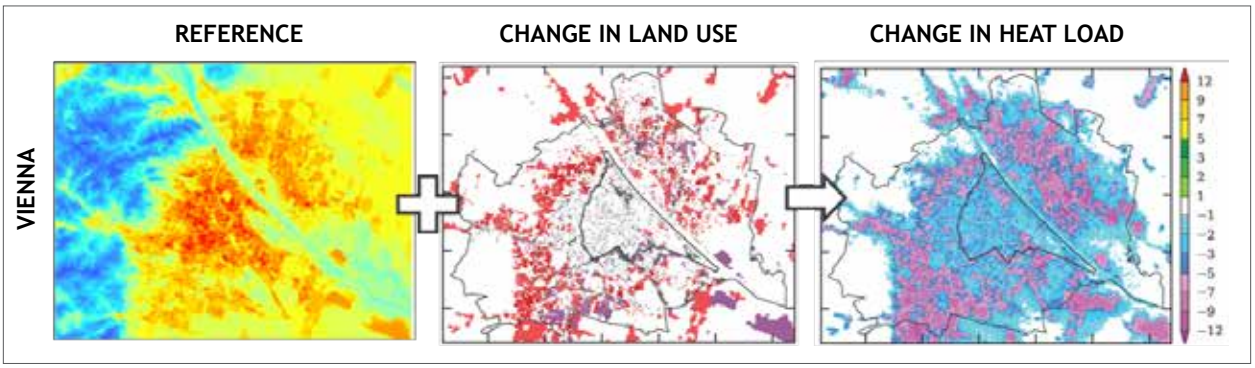

*Source:* Bitdefender.

Figure 27: Heat Risk Management.




*Source:* ZAMG.

Figure 28: Change in heat load based on change in land use.




*Source:* ACRP (Austrian Climate Research Program project FOCUS-I.

governments and businesses to apply them specifically to their operations and their industries.

In addition, building preparedness indices that measure how well a country is provisioned to fight an outbreak (such as the Joint External Evaluation scores calculated by the World Health Organization) helps governments understand where and how a pandemic is most likely to spread and how well the public health sector in a specific geography is prepared to respond.

## Cybersecurity

The European Directive on Security of Network and Information Systems (Directive (EU) 2016/1148 of the European Parliament and of the Council) states that "responsibilities in ensuring the security of network and information systems lie, to a great extent, with operators of essential services and digital service providers. A culture of risk management, involving risk assessment and the implementation of security measures appropriate to the risks faced, should be promoted and developed through appropriate regulatory requirements and voluntary industry practices."

In this respect, the following risk mitigation options are available:

- **Assume/accept.** Acknowledge the existence of a particular risk and make a deliberate decision to accept it without engaging in special efforts to control it.
- **Avoid.** Adjust program requirements or constraints to eliminate or reduce the risk. This adjustment could be accommodated by a change in funding, schedule, or technical requirements.
- **Control.** Implement actions to minimize the impact or likelihood of the risk.
- **Transfer.** Reassign organizational accountability, responsibility, and authority to another stakeholder willing to accept the risk.
- **Monitor.** Monitor the environment for changes that affect the nature and/or the impact of the risk.

Acknowledging that the variety of attacks implies a targeted, personalized approach leads to a whole menu of cyber risk technical controls developed by cybersecurity experts.

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# An urgent matter in our homes: Tackling challenges of earthquake risk reduction in the housing sector

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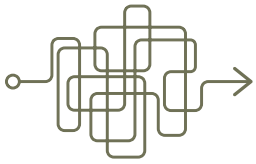
## Session Summary

This session considered the often unseen dangers in our homes, namely earthquake risk in the housing sector. Our homes play a central role in our lives: they shelter our families, give us a sense of security and belonging, and are often the most highly priced asset that we own. But today, residents in Europe and around the world are facing many challenges associated with rapidly aging building infrastructure, which urgently needs better management, maintenance, and capital improvements, including for energy efficiency.



"In large earthquakes 90 percent of damaged buildings are our homes."

—*Source:* Comerio 1997, 1998.

Apartment block in Transylvania, Romania. Photo: coldsnowstorm.

## Background

In Europe and Central Asia, multifamily residential buildings that were built during the period spanning the 1950s to the 1990s are of particular concern. Unfortunately, previous large earthquakes—such as those in Skopje (1963), Tashkent (1966), Vrancea (1977), Spitak (1988), and more recently Albania (2019)—have shown that the residential sector in this region remains very vulnerable. Previous experience shows that the housing sector is responsible for as much as 90 percent of all damaged buildings (Comerio 2004), and it also concentrates the majority of financial losses, leaving many families reliant on shelter and financial support from the government, family, or friends. While there is an obvious need to address the risk in the housing sector, risk reduction in privately owned multifamily buildings is a complex issue, where the financial means and readiness to act among different residents of the same building can vary drastically.

**Figure 29:** Residential large panel building in Plovdiv, Bulgaria.

*Source:* Mott MacDonald, Bulgaria.

## Case Studies

### Evolution of multifamily residential construction and earthquake vulnerability across Europe and Central Asia (presented by Manya Deyanova)

Major cities across Eastern Europe and Central Asia exhibit similar housing trends: the majority of the urban population (~50–80 percent) lives in multifamily apartment buildings, and more than 50 percent of the population lives in apartments built between the 1960s and 1990s. In fact, three major structural groups can be distinguished among the multifamily buildings based on changes in the construction practice throughout the years. The first group is buildings built predominantly before the 1960s—e.g., adobe and wooden houses, unconfined and confined masonry multifamily buildings (these also continued to be built after the 1960s). The second group of buildings is particular to the 1960–90 period; these were built very quickly to make up for housing shortages during the Soviet era, which saw rapid urbanization. These types of buildings are characterized by mass construction, standardized designs, and prefabricated structural elements, and they include precast reinforced concrete frames and large panel buildings. The last group of buildings is the post-1990 construction types, such as in situ reinforced concrete frames with masonry infill, shear walls, and dual systems.

When it comes to earthquake safety among the different building groups, a common misconception is that seismic vulnerability of buildings decreases as the year of construction increases. While evolution of seismic codes does improve structural safety, it does not always mean that more recently built buildings are safe and older buildings less so. For example, a recent study on large panel buildings built during the Soviet era showed that if these buildings were built with high construction quality and were well maintained, their seismic safety was higher than that of other building types of that time or even more modern ones (World Bank and GFDRR, draft). On the other hand, more recent building types, such as reinforced concrete frames with masonry infill, can suffer extensive damage, as seen in the 2019 Albania earthquake. Earthquake vulnerability is dependent not only on building age, but also on other factors, such as poor construction quality, post-construction modification, and dangerous "collapse" mechanisms (e.g., soft story), which can be present across different types of construction.

### The market for unsafe buildings (presented by Marina Batog)

Unfortunately, in many places in Europe and Central Asia, poverty

and earthquake vulnerability of buildings is interwoven; thus following a large event the less fortunate are also the ones who suffer the most human and economic losses. Strong housing policies have the potential to address this issue, but more often we see that the lack of proper policies creates a market for unsafe building. One such example is Bucharest, where housing is unaffordable for many, and policies and investments to promote subsidized and safe housing are not systemic. As a result, those who cannot afford to buy or rent well-maintained and safe housing on the market are typically left with three possible scenarios: rent apartments in seismically risky, thus cheaper, buildings; illegally occupy or "squat" in dilapidated and unsafe buildings; or live in areas with low real estate prices given unsafe insalubrious housing conditions. A market for unsafe homes is created, tolerated, and in some cases even incentivized, by lack of housing policies.

So how does one successfully integrate housing policy with effective risk reduction? Demand-based interventions could consist of providing affordable safe housing alternatives tailored to the financial capabilities and needs of people currently living in unsafe conditions. Residents who live in seismically unsafe buildings should be made aware of the risk they are exposed to and offered alternatives, so that no one is forced to live in unsafe conditions. Potential offer-based interventions could include restricting the use of unsafe buildings for revenue-generating activities (e.g., short-term rentals, B&Bs), facilitating and incentivizing retrofit or redevelopment, and informing owners of their responsibilities and risk. There is also a need for governments to start asking and answering the difficult question about the trade-offs between addressing unsafe housing and public dangers versus protecting the right to private property, as in the case of condominiums: what if one private owner's refusal to invest in retrofitting puts other residents and people at risk?

### Lessons from the 2010–11 Canterbury earthquakes in New Zealand
(presented by Kelvin Berryman)

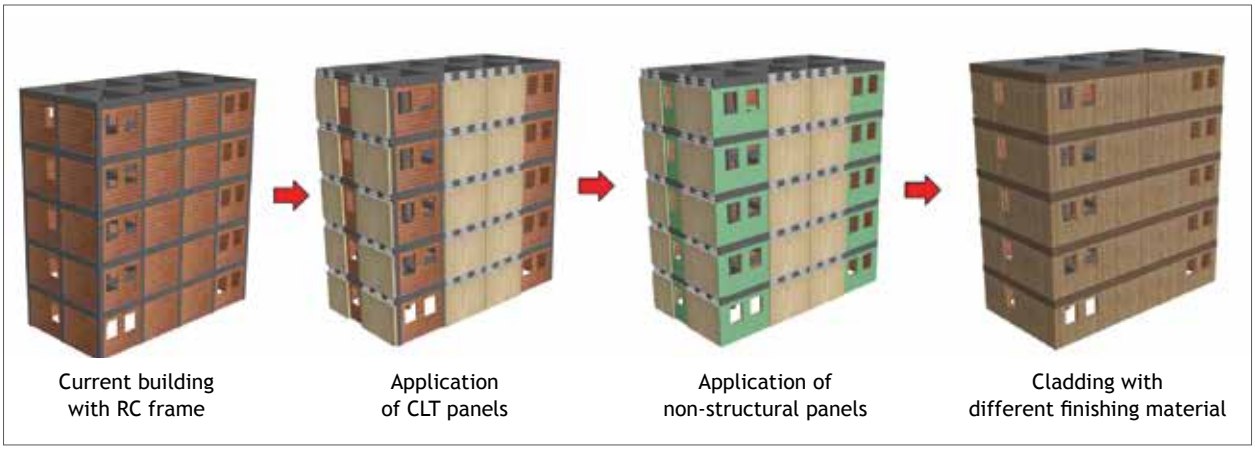
In New Zealand, the destructive 2010–11 Canterbury earthquake sequence was a real test for the country's earthquake preparedness and resilience of the housing sector. In general, the performance and recovery of residential buildings was considered to be relatively good. The good performance can be attributed to the safe building types (mostly wooden houses, which perform well in earthquakes), and high residential insurance penetration. The majority of the damage in the residential buildings was caused by secondary perils, such as liquefaction (greater than 50 percent of losses), lateral spreading, and rockfall. One critical aspect of New Zealand's recovery following the earthquakes was that the country had the highest ratio of insured to economic losses, since residential earthquake insurance is essentially mandatory (bank mortgages require insurance cover). Overall, insurance and reinsurance covered ~60 percent of rebuilding costs, thereby preventing many residents from going into financial debt as a result of reconstruction.

There are several key takeaways from the Canterbury earthquakes. Resilient housing allows people to "shelter in place" following a large earthquake event, which leads to improved psychosocial outcomes and workforce availability to maintain business activity. The building code needs to keep up to date with hazard knowledge and should extend from life safety objectives (structural failure) to protecting social and economic futures as well (safe occupancy,

**Figure 30:** Example of liquefaction damage during the Canterbury earthquake sequence.

Photo courtesy of Kelvin Berryman.

**Figure 31:** Use of CLT panels to improve seismic safety and energy efficiency.




Source: Giuseppe Margani.

functionality, provision of services).

Policies and land use planning are urgently needed to address legacy issues in existing building stock and to address secondary perils of earthquake such as liquefaction, landslides, and tsunami. National disaster insurance pools need large penetration. Lastly, improved risk literacy among the public and the private sector can have a major impact on resilience via risk-informed decision making and improved social capital.

### Opportunities for understanding and reducing risk in the housing sector (presented by Manya Deyanova and Giuseppe Margani)

In order to evaluate the risk in residential buildings, we need to develop and promote standard guidelines for seismic safety assessment, including consideration of "as is" condition of the buildings and not just the "as designed" structural deficiencies. In addition, guidelines for structural seismic retrofitting and nonstructural improvements of residential buildings need to be developed for engineers, homeowners, and municipalities.

The process of quality control and approval of safety assessments is key and should be streamlined. Opportunities should also be taken to integrate seismic structural assessment and upgrade with any ongoing programs for building improvements (e.g., energy efficiency improvements).

In order to solve the issue of seismic safety in existing buildings, researchers and engineers have started to come up with creative and cost-efficient solutions, such as addition and sale of floors in large panel buildings to finance structural retrofit of the buildings. Many of the European countries are currently making sizable investments in improving energy efficiency, but in seismic countries, any solution that addresses only energy efficiency can turn out to be futile if an earthquake occurs. Interventions for energy efficiency and seismic retrofitting typically exist separately, and they can lead to high occupant disturbance, long intervention times, and high costs. There is, however, an opportunity to use new innovative solutions that aim to combine energy efficiency and seismic upgrade in an integrated way in order to overcome the abovementioned barriers. One possible solution is the external addition of prefabricated structural cross-laminated timber (CLT) panels, which improve global seismic safety. The structural CLT panels are combined with other nonstructural, customizable, prefabricated panels made up of a light wooden structure. Both panels are coupled with insulating materials to increase energy efficiency. Such an approach uses external intervention with prefabricated components, which optimizes cost, helps avoid relocation of the residents, and reduces construction time.

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# What is Understanding Risk?

Understanding Risk (UR) is an open and global community of over 8,000 experts and practitioners interested and active in the creation, communication, and use of disaster risk information. This vibrant community—a diverse group of people from the private, public, nonprofit, technology, and financial sectors—meets at the UR global forum every two years. Each iteration of the UR Forum has produced new ideas and partnerships that have improved risk information and helped to integrate evidence into policy making and development planning.

This publication captures the experiences, lessons, and best practices in the field discussed at the Understanding Risk Europe Conference, held in Bucharest, Romania, from November 27 to November 29, 2019.

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