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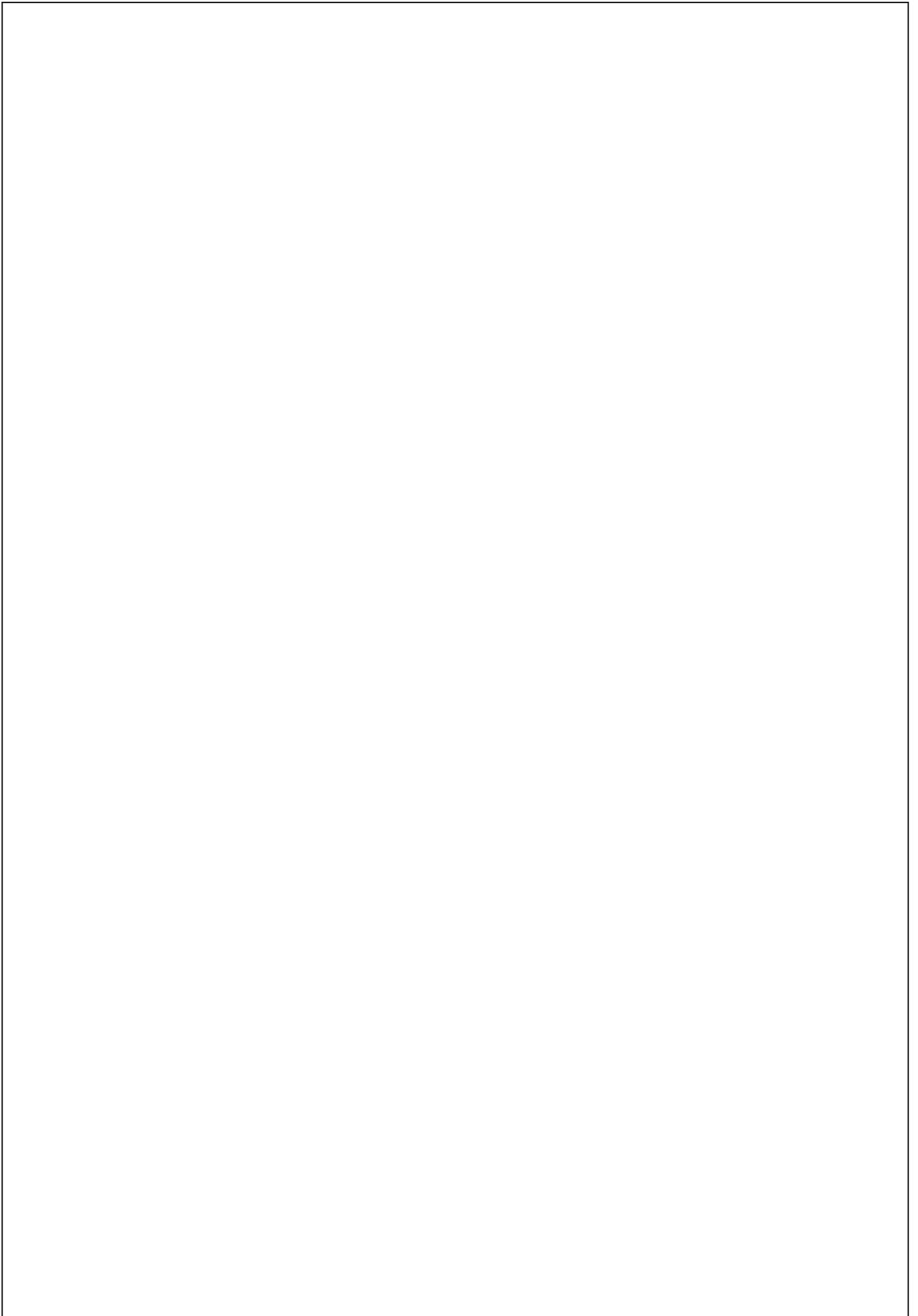
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Date

Dissemination Level		
PU	Public	X
PP	Restricted to other programme participants (including the Commission Services)	
RE	Restricted to a group specified by the consortium (including the Commission Services)	
CO	Confidential, only for members of the consortium (including the Commission Services)	



Abstract

Deliverable D8.14 “MATRIX results to disaster management community” summarizes the activities carried out during the MATRIX project that aimed at providing the project’s results to National Platforms for Disaster Risk Reduction, the UN-ISDR, EU, CoE and the private sector, the latter including insurances companies and operators of critical infrastructures (e.g., energy suppliers and railway companies).

Different types of communication were chosen in order to convey the MATRIX results to the various communities.

Since the dissemination of MATRIX results to the relevant communities is a continuous task, some activities are still underway, for example the publication of MATRIX results on the homepages of national civil protection authorities or in civil protection magazines. Hence, the current document describes activities that have already been concluded and on-going activities that are expected to be continued until the end of the project.

Acknowledgments

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1 MATRIX Results to Disaster Management Community

MATRIX results were communicated to different groups, with a focus on the disaster management community (DMC) within the context of WP8 “Dissemination/end users”. In addition to the National Platforms for Disaster Risk Reduction and civil protection authorities, the UN-ISDR, EU, CoE and the private sector, including insurances companies and operators of critical infrastructures (e.g., energy suppliers and railway companies), were involved and continuously informed and updated about MATRIX.

In Europe altogether 22 National Platforms for Disaster Risk Reduction exist. MATRIX interacted with 13 National Platforms for Disaster Risk Reduction, civil protection authorities and designated representatives or their members.

Different types of communication were used in order to convey the MATRIX results to the above mentioned communities:

- **MATRIX Stakeholder Workshops:**
 - Information about MATRIX IT-tools (Concept Note 1st Stakeholder Workshop)
 - Information about MATRIX case studies (Concept Note 2nd Stakeholder Workshop)
- **Involvement of stakeholders in the General Assembly meetings.**
- **MATRIX results at national levels - the involvement of Cooperation Partners (e.g., publications in civil protection magazines).**
- **Publications in the appropriate academic (scientific and engineering) journals.**
- **Presentations at disaster management meetings, workshops, presentations at the EU level (DG ECHO) and the European Forum for Disaster Risk Reduction.**
- **Other dissemination activities**, for example, MATRIX cooperation request letter, fact sheets, dissemination at GRIPWEB, MATRIX information in the annual reports of National Platform (DKKV) and Integrated Research on Disaster Risk (IRDR) annual reports.

1.1 MATRIX Stakeholder Workshops

DKKV, together with KIT and GFZ, organised two MATRIX Stakeholder Workshops – the 1st Stakeholder Workshop took place in early June 2012 at the DKKV premises in Bonn and the 2nd Stakeholder Workshop in late June 2013 in Königswinter/Bonn. These workshops enabled the MATRIX community to convey important research results to selected European National Platforms for Disaster Risk Reduction and the private sector. Taking into account the needs of the disaster manager community, both workshops focused on methods and tools, the MATRIX case studies and risk-governance. In particular, the workshops conveyed the following aspects and results of the MATRIX project:

- Aims, general work scheme and outline of MATRIX.
- The multi-type concept, including the need to consider the spatial and temporal interactions and dynamics at the hazard, risk, exposure, vulnerability and socio-economic levels. Of particular importance was the consideration of the results from WP3 “Cascade effects in a multi-hazard approach” and WP5: “Framework for multi-type risk assessment”. This included the collection of the various possible cascade scenarios that could arise in the test cases (MS3 “Scenario collection”).

- Benefits of the multi-type approach (i.e., more efficient usage is expected of disaster mitigation resources).
- Importance of the socio-economic aspects of risk assessment within a multi-type hazard and risk environment (e.g., **Task 4.3** “Social and economic vulnerability”).
- Results from WP 6 “Decision support for mitigation and adaptation in a multi-hazard environment” were conveyed, in particular those related to **Task 6.1** “Moving from single-hazard to multi-hazard decision-analytic methods“. Within this context, KIT presented the Decision Support Tool during the first workshop and a subsequent meeting held at the headquarters of Federal Office of Civil Protection and Disaster Assistance (BBK) at the beginning of July 2013.
- MATRIX IT tools, in particular the MATRIX CITY and Virtual city developed within WP7 “Virtual City and test cases”, specifically **Task 7.1** “Common IT framework for test case analysis” and **Task 7.2** “Implementation and analysis of the virtual city”¹.
- **Task 7.3** “Implementation and analysis of the Naples test case”, which is strictly related to WP3 activities, in particular to **Task 3.3** “Development of Bayesian and non-Bayesian procedures to integrate cascade events in a multi-hazard assessment scheme” and **Task 3.4** “Development of a multi-hazard model to be integrated in multi-risk software”².
- **Task 7.4** “Implementation and analysis of the French West Indies test case”, including results from the deliverable D4.3 “Functional vulnerability: Report on the functional vulnerability assessment of a system prone to multiple hazards”.
- **Task 7.5** “Implementation and analysis of the Cologne test case”, including results from deliverable D2.3 “Harmonisation strategy”.

The presentation of the cross-cutting results of WP7, in particular the MATRIX test cases, which call upon the methodologies and approaches explored in WP2 to WP6, during the 2nd MATRIX Stakeholder Workshop, enabled the MATRIX members to present and convey different aspects of the MATRIX project and the approaches being developed to the representatives of the other projects and civil protection.

In preparation for the MATRIX workshops, two concept notes were disseminated, the first comprising of information about the MATRIX IT methods and tools, and the second about the test cases. In addition to a paper being submitted to the International Journal of Disaster Risk Reduction, partially in response to the first workshop, the following actions have also been done/are underway following the second workshop:

- The detailed minutes of the 2nd MATRIX Workshop (see Appendix 4).
- Analysis of the feedback sheet from the 2nd MATRIX Workshop (on-going).

¹Note these are related to the deliverables D7.1 “MATRIX IT platform: Report on the MATRIX common IT platform” and D7.2 “Implementation and analysis of the Virtual City”.

²These tasks are related to deliverables D3.4 “Probabilistic Framework” and D3.5 “Software for multi-hazard assessment”.

1.2 Involvement of stakeholders in the General Assembly meetings

Selected stakeholders have been regularly invited to and have participated in the General Assembly meetings of MATRIX. This activity allowed the consortium to convey the MATRIX results and describe the project tasks to these groups. The groups involved were:

- Federal Office of Civil Protection and Disaster Assistance (BBK)
- UK Cabinet Office
- Italiana Civil Protection Department (DPC)
- European Commission (EC)

1.3 Involvement of private sector and operators of critical infrastructures

All active Cooperation Partners of MATRIX, as listed in Appendix 1, were asked to involve private sector groups and operators of critical infrastructures in the 2nd MATRIX Stakeholder Workshop. Although the Cooperation Partners provided promising contacts to different enterprises, the involvement of the private sector in projects such as MATRIX remains a challenging task. However, the various enterprises were informed about the MATRIX project. The following contacts were provided by the cooperation partners, and used in terms of deciding who to invite to the 2nd MATRIX Stakeholder Workshop.

- BBK, as member of the DKKV, asked internally several operators of critical infrastructures to join the 2nd MATRIX Stakeholder Workshop.
- RWE Germany AG.
- The German Railway (DB).
- Telekom Italia.
- Telekom Germany.
- ENI – gas and energy suppliers.
- Enel Italia – national electric company.
- SNAM – gas network company in Italy.
- Italgas – gas network company.
- Wind – Italian telephone company.
- H3d – Italian telephone company.
- Siminn – telephone company in Iceland.
- Vodafone Iceland.
- Terna – Italian electricity supplier.
- Italian Mail.
- Landsnet – operator and administrator of electricity transmission systems.
- PFS - Icelandic Post and Telecom Administration.
- NVE - Norwegian Water Resources and Energy Directorate.
- Stiftelsen Det Norske Veritas (DNV) – A foundation with the objective of “Safeguarding life, property, and the environment”.
- Munich RE was asked to participate in the 3rd General Assembly meeting.
- The German Insurance Association (GDV).

The German Insurance Association in fact attended the 2nd MATRIX Stakeholder Workshop, while some other companies were not able to attend, but expressed interest of receiving further information about MATRIX. The minutes of the workshop have been also shared with:

- The Icelandic Natural Hazard Insurance Company
- The Austrian Railway (ÖBB)

Furthermore, selected stakeholders will be invited to the 3rd General Assembly meeting, as outlined above.

1.4 Involvement of EC and CoE

The European Commission and the Council of Europe (CoE) have been informed about MATRIX activities and results throughout the project's lifetime. Both entities have positively responded to, and confirmed, the initial cooperation request letter at the beginning of the project. Examples of the activities MATRIX engaged in with the EC include several expert meetings, including those sponsored by the European Commission Humanitarian Aid and Civil Protection (ECHO), and a workshop on the need for interactions between the physical/engineering and social/economic sciences, held in Brussels on 22-23 October, 2012. MATRIX was presented at 4th European Forum for Disaster Risk Reduction attended also by the CoE and the EC.

1.5 Publications - MATRIX results at national levels - supported by Cooperation Partners

DKKV and ETH Zürich have prepared an article which is intended to be used in different countries in terms of dissemination (Title: MATRIX – new methods and tools for multiple risks). The article comprises information about the MATRIX multi-risk approach, the MATRIX IT framework, the MATRIX case studies and the interactions of MATRIX with National Platforms for Disaster Risk Reduction. The article was published in German in the "Bevölkerungsschutz" magazine of the Federal Office of Civil Protection and Disaster Assistance (BBK) and on the website of the Ministry of Life of Austria³.

Additional related activities planned and underway include the following:

- Centre for Climate and Safety (CCS) of Karlstad University, Sweden, published a short summary of the 2nd MATRIX Stakeholder Workshop and to put a link to the English version of the MATRIX article⁴.
- The Italian Civil Protection Department (DPC) plans to publish the above mentioned article in the upcoming issues of the Civil Protection magazine (PROTEZIONE CIVILE).
- An article was published at the SEERISK project website⁵ about the 2nd MATRIX Stakeholder Workshop. The project is led by the National Directorate General for Disaster Management (NDGDM).
- There are preliminary agreed-upon thoughts about a joint paper, which is planned to be published jointly with the Institute of Meteorology and Water Management, the National Research Institute (IMGW), which is the Polish National Platform for DRR, within the contexts of MATRIX and ISOK. ISOK is a national project with the aim of establishing a

³ <http://www.naturgefahren.at/projekte/Matrix.html>

⁴ <http://matrix.gpi.kit.edu/Downloads.php>

⁵ <http://www.seeriskproject.eu/>

national IT system covering the country's protection against extreme hazards⁶. Within the framework of this publication, the following actions are planned:

- To identify the added values of integrating the multi-risk approach into national risk analysis systems for decision makers and operational purposes.
- To evaluate the integration potentials and possibilities of the MATRIX-IT systems and the multi-risk approaches into future developments of decision support applications based on the example of the ISOK system (including the decision support part of the ISOK-system and maybe also other ISOK components).
- Furthermore, it could identify requirements for the operational use of the MATRIX systems based on the ISOK approach.

Finally, the Cooperation Partners have been asked to publish the article "MATRIX – new methods and tools for multiple risks" in other appropriate magazines and to make the article available on their homepages. Financial support has been offered for translations into the language of the country.

1.6 Scientific publications

Based on the results of the 1st MATRIX-Stakeholder Workshop, a joint paper was prepared together with Cooperation Partners and was submitted at the end of June 2013 to the International Journal of Disaster Risk Reduction. For details and all publications of the MATRIX consortium, see the list of publications – Appendix 2.

In addition, an abstract was submitted to the ISDR Global Assessment Report 15 on a multi-risk approach to develop and strengthen local capacities for disaster risk reduction on 09.09.2013.

1.7 Disaster management meetings, workshops, presentations and other interactions

MATRIX results have been presented during a number of different types of events. For a listing of all interactions, see Appendix 3. Additional planned activities include:

- Presentation of MATRIX results during the European Forum for Disaster Risk Reduction held in Oslo from 23-25 September 2013. The European National Platforms is the major event for European National Platforms.
- Presentation of MATRIX results during a conference organised by ETH Zurich "Resilience in crisis situations" 11. October 2013. Foreseen audience: academia, politics, private sector.
- Presentation of the MATRIX project and participation in an expert panel during the final KULTURisk⁷ meeting, to be held in Venice in September, 2013.

⁶ <http://www.isok.gov.pl/en/about-the-project>

⁷ Knowledge-based approach to develop a cULTure of Risk, <http://www.kulturisk.eu/>

2. Feedback on MATRIX

Different feedback mechanisms have been established during the project and opportunities have been taken to receive feedback. These include:

- An extensive questionnaire was submitted to the participants before the 1st MATRIX Workshop. For the synthesis of the results, see deliverable D8.11 “Contacts to National Platforms IV”.
- Feedback was obtained during the two MATRIX Stakeholder Workshops. For detailed information, please refer to the minutes of these workshops:
 - For the minutes of the 1st MATRIX Stakeholder Workshop, see deliverable D8.11 “Contacts to National Platforms IV”
 - For the minutes of the 2nd MATRIX Stakeholder Workshop, see Appendix 4 (final draft version - comments from Cooperation Partners are still pending).
- Feedback received during all General Assembly Meetings from the attending stakeholders.
- Two workshop feedback sheets were submitted to the participants of 1st and 2nd MATRIX Stakeholder Workshops. The analysis of the feedback sheets were presented in deliverable D8.12 “Contacts to National Platforms V”. The second feedback sheet includes questions related to Task 4.3 “Social and economic vulnerability” and to the results of WP6 about “Barriers and benefits to multi-risk governance”. MATRIX members of WP6 and WP7 were involved in the 2nd MATRIX Stakeholder Workshop and presented detailed results to the stakeholders.
- Feedback from Cooperation Partners was received about the scientific paper “Evaluating stakeholder perceptions in multi-hazard and multi-risk decision support models”, submitted to the International Journal of Disaster Risk Reduction. During the 1st MATRIX Stakeholder Workshop, it was agreed to prepare the document jointly with the stakeholders.
- MATRIX received feedback from Federal Office of Civil Protection and Disaster Assistance (BBK) on the multi-criteria Decision Support Tool during a follow-up meeting of the 1st MATRIX Stakeholder Workshop. This meeting took place on 5th July 2013. During the meeting, feedback was received on the applicability and requirements for such a tool.
- ETH Zurich received feedback on the MATRIX CITY platform (MATRIX Common IT sYstem) and the concept of Virtual City during the 12th PPRD South “Prevention and preparedness” workshop in Lisbon, Portugal, October, 2012.

Furthermore, the analysis of the results of the second feedback sheet and a synthesis of both feedback sheets will be conducted within the framework of deliverable D8.15 “Platforms and MATRIX Community: Performance evaluation of interaction between platforms and MATRIX community”.

3 Conclusions

MATRIX initiated various interactions with the Cooperation Partners including two MATRIX Stakeholder Workshops enabling to convey the most important and relevant findings for the specified target group, being the disaster management community. The general outline, the IT tools, methodologies and the MATRIX case studies were presented in depth to this community. Cooperation Partners were also involved into the MATRIX annual meetings giving even more insights into the project progress. Face-to-face meeting like these proved to be useful to receive feedback and recommendations from the stakeholders. More formally feedback was captured by different feedback rounds before and after the MATRIX Workshops.

Dissemination material developed by MATRIX was not only used to inform Cooperation Partners (e.g. MATRIX fact sheet). Interestingly, Cooperation Partners also used information provided by MATRIX or even formulated own short contributions to disseminate results through their communication channels. Scientific publications and publications in disaster management journals as well as the integration of the private sector and the involvement of the EC, CoE and the ISDR completed the dissemination activities in MATRIX.

The next important step will be to evaluate the interaction between the National Platforms and the MATRIX team within the framework of deliverable D8.15 “Platforms and MATRIX community”.

Appendices

Appendix 1 - Status of cooperation as of 17.07.2013

Country	Status of cooperation	Organisation	Contact persons	Position	1 st MATRIX Stakeholder Workshop	2 nd MATRIX Stakeholder Workshop
Austria	Confirmed cooperation	Federal Ministry of Agriculture, Forestry, Environment and Water Management	Mr PICHLER Andreas and Mr JACHS, Siegfried (Federal Ministry of the Interior in CC)	Austrian Service for Torrent and Avalanche Control	Mr PICHLER Andreas	No attendance
Bulgaria	Confirmed cooperation	Ministry of Interior - DG Fire Safety and Protection of the Population	Ms STANIMIROVA	Head of International Cooperation, NATO, EU and Humanitarian Operations Unit DG Fire Safety and Civil Protection Ministry of Interior Republic of Bulgaria	No attendance	Ms STANIMIROVA, Maria
Czech Republic	Confirmed cooperation	Czech National Committee for Natural Disaster Reduction	Mr OBRUSNIK Ivan	Former Director CHMI	No attendance	No attendance

Country	Status of cooperation	Organisation	Contact persons	Position	1 st MATRIX Stakeholder Workshop	2 nd MATRIX Stakeholder Workshop
Croatia	Confirmed cooperation	National Protection and Rescue Directorate	Ms BILJAKOVIC Katica and Ms IVANCAN-PICEK Branka,	Scientific advisor at Institute of Physics, Zagreb; Representative of the Ministry of Science in CCPDR (Committee of Croatian Platform for Disaster Reduction)	Ms BILJAKOVIC Katica	Mr MLADINEO, Nenad, Prof. Faculty of Civil Engineering, Architecture and Geodesy University of Split
France	Confirmed cooperation	Ministère de l'Écologie, de l'Énergie, du Développement durable et de la Mer	Mr GERARD François	Former Chef du bureau information préventive, coordination et prospective MEEDDAT / DGPR / SRNH / bipcp	Mr GERARD François	Mr GERARD François
Germany (BBK)	Confirmed cooperation	German Committee for Disaster Reduction and Federal Office of Civil Protection and Disaster Assistance (BBK)	Ms CLEMENS-MITSCHKE Angela & GEIER Wolfgang Ms LENZ Susanne Ms STOLZENBURG Kathrin, Mr REIF Simon, Ms KRINGS Susanne	Head of Departement II.1 - General policy issues of civil protection (population protection); risk management; emergency preparedness	Ms LENZ Susanne	Ms STOLZENBURG Kathrin, Mr REIF Simon, Ms KRINGS Susanne

Country	Status of cooperation	Organisation	Contact persons	Position	1 st MATRIX Stakeholder Workshop	2 nd MATRIX Stakeholder Workshop
Hungary	Cooperation confirmed	National Directorate General for Disaster Management - Ministry of Interior	Ms RAJICIC Ágnes Mr SZÉKELY Miklós and Ms HORVATH Anikó	Senior Desk Officer - Department for International Relations and Legal Affairs	No attendance	Mr SZÉKELY Miklós and Ms HORVATH Anikó
Italy	Confirmed cooperation	Civil Protection Department	Mr SABETTA Fabio and Mr ROSSI Luca	Department - Seismic and Volcanic Risk	Mr SABETTA Fabio	Mr SABETTA Fabio
Liechtenstein	Cooperation not confirmed	Department of Civil Protection	Mr BANZER Emanuel	Chief officer	No attendance	No attendance
Norway	Confirmed cooperation / sharing of some expertise and participation in MATRIX workshops	Directorate for Civil Protection and Emergency Planning	Mr HOGVOLD Dag Olav and Mr. LARSEN Nils	Senior adviser - Research and analysis	Mr. LARSEN Nils	No attendance
Poland	Confirmed cooperation	Institute of Meteorology and Water Management Branch Office in Cracow (IMGW)	Mr WALCZYKIE-WICZ Tomasz	Division of Water Management	No attendance	No attendance
Spain	Cooperation not confirmed	Dirección General de Protección Civil y Emergencias	Mr LAHORE Juan Pedro	Director	No attendance	No attendance
Sweden	Swedish NP proposes to contact the following institutions and bodies instead, to act as cooperation partners: 1. Center for climate and	Swedish Civil Contingencies Agency (MSB)	Ms LINDAHL OLSSON Mette and Ms POSTGARD Ulrika	Head of Natural Hazards & Critical Infrastructure Section - Risk & Vulnerability Reduction	N/A	N/A

Country	Status of cooperation	Organisation	Contact persons	Position	1 st MATRIX Stakeholder Workshop	2 nd MATRIX Stakeholder Workshop
	safety 2. Centre for Natural Disaster Science 3. Department of Fire Safety Engineering and systems 4. Municipality of Karlstad			Department		
Sweden	Confirmed cooperation	Department of Fire Safety Engineering and systems	Mr PETERSEN Kurt	Prof.	N/A	N/A
Sweden	See →Center for Climate and Safety	Center for Natural Disaster Science	Mr HALLDIN Sven	Prof.	N/A	N/A
Sweden	Confirmed cooperation	Center for Climate and Safety	Mr NYBER Lars	Coordinator	Mr NYBER Lars	Mr NYBER Lars
UK	Confirmed cooperation	Cabinet Office	Mr BARNES Steven Ms DAVIS Sarah	Policy Manager Civil Contingencies Secretariat	No attendance	Ms DAVIES Sarah Senior Met Office Advisor (Civil Contingencies)
Iceland	Participation in the 2 nd MATRIX Stakeholder Workshop to be confirmed	Iceland - Department of Civil Protection and Emergency Management	Mr. REYNISSON Viðir and Mr GYLFASON Ágúst Gunnar	Department Manager	No attendance	No attendance
Iceland	Confirmed cooperation	Icelandic Met Office	Ms KARLSDOTTIR Sigrún	Director of Natural Hazards	No attendance	Ms KARLSDOTTIR Sigrún
German Insurance Association (GDV)	Confirmed cooperation	N/A	Mr BURGHOFF, Olaf	Head of Statistics and Hazard	No attendance	Mr BURGHOFF, Olaf

Country	Status of cooperation	Organisation	Contact persons	Position	1 st MATRIX Stakeholder Workshop	2 nd MATRIX Stakeholder Workshop
				Modelling Division		
CoE	Confirmed participation and the sharing of expertise with MATRIX	European and Mediterranean Major Hazards Agreement (EUR-OPA) Council of Europe	Mr FERNÁNDEZ-GALIANO Eladio	Executive Secretary	No attendance	No attendance
EC	Confirmed participation and the sharing of expertise with MATRIX	European Commission - DG - ECHO Humanitarian Aid and Civil Protection - Unit ECHO C3 Civil Protection - Disaster Response	Mr DE-LANNOY Thomas		No attendance	No attendance
ISDR Europa	Confirmed participation in the area of dissemination and participation in workshops	United Nations International Strategy for Disaster Reduction, UNISDR	Ms DANNENMANN Stefanie	Programme Officer	Ms DANNENMANN Stefanie	No attendance

Appendix 2 – Publications

Title of Publication	Short Description	Publisher	Readership	Author(s)	Contrib. Partners	Status	Publication Date (expected)
Integration of stochastic models for long-term eruption forecasting into a Bayesian event tree scheme: a basis method to estimate the probability of volcanic unrest	Main objective in this paper is to provide a quantitative framework to calculate probabilities of volcanic unrest.: http://link.springer.com/article/10.1007/s00445-013-0689-2	Bull. Volcano, DOI: 10.1007/s00445-013-0689-2 (Journal paper)		A. Garcia-Aristizabal, J. Selva, and E. Fujita	AMRA	Published	2013
Basic principles of multi-risk assessment: a case study in Italy	The assessment of the impact of different catastrophic events in a given area requires innovative approaches that allow risks comparison and that account for all the possible risk interactions. In this paper, we put forward some basic principles for multi-risk assessment, and we consider a real application to Casalnuovo municipality (Southern Italy), in which we face the problem to make different hazards comparable, and we highlight when and how possible interactions among different threats may become important. available at: http://www.springerlink.com/content/n7x17mww07001776/	Nat. Hazards, 62(2), 551-573 DOI: 10.1007/s11069-012-0092-x (Journal paper)	Scientific and operational disciplines for hazard mitigation	W. Marzocchi, A. Garcia-Aristizabal, P. Gasparini, M. L. Mastellone, and A. Di Ruocco	AMRA	Published	2012
Seismic and volcanic risk assessment in a multi-risk framework	IAVCEI scientific assembly 2013, Kagoshima, Japan. July 2013	scientific conference presentation and abstract		A. Garcia-Aristizabal, J. Selva, A. Di Ruocco, W. Marzocchi, and P.	AMRA		July 2013

Title of Publication	Short Description	Publisher	Readership	Author(s)	Contrib. Partners	Status	Publication Date (expected)
considering interactions				Gasparini			
Assessing cascading effects in multi-hazard and multi-risk analyses: Examples from Naples, Italy	Scientific conference presentation and abstract	Geophysical Research Abstracts, Vol. 15, EGU2013-9969, 2013, EGU General Assembly 2013		A. Garcia-Aristizabal, A. Di Ruocco, W. Marzocchi, and P. Gasparini.	AMRA		
Time-dependent seismic reliability of damage-cumulating non-evolutionary bilinear systems	<p>A model for time-dependent reliability assessment of structures, subjected to cumulating damage due to point seismic overloads, is presented. The deteriorating structural parameter is the capacity of the structure expressed in terms kinematic (monotonic) ductility to conventional collapse. A stochastic process is employed to model the progressive loss of capacity during a time interval of interest. The capacity reduction due to earthquake shocks is analysed for a simple bilinear structural system, for which earthquake damage increments are non-negative, independent and identically distributed random variables.</p> <p>Basing on the presented model, close-form solution for life-cycle structural assessment are derived and discussed with respect to different possible knowledge levels.</p>	Proc. of 15 WCEE		I. Iervolino E. Chioccarelli M. Giorgio	AMRA		2012
Un modello tempo-dipendente per l'affidabilità strutturale in caso di danno sismico cumulato (<i>In Italian</i>)	<p>It is studied a stochastic model for time-dependent reliability assessment of structures at the scale of life-cycle. The main considered degradation phenomenon is the cumulative damage due to point overloads (i.e., earthquakes). A simple bilinear structural system is considered. It is characterized by non-negative independent and identically distributed damage increments due to earthquakes.</p>			I. Iervolino M. Giorgio E. Chioccarelli	AMRA	IF CRASC	2012

Title of Publication	Short Description	Publisher	Readership	Author(s)	Contrib. Partners	Status	Publication Date (expected)
Bayesian Belief Network Analysis of the Santorini Seismo-Volcanic Crisis	A seismo-volcanic crisis developed on the Greek island of Santorini in 2011-2012. A Bayesian Belief Network analysis has been undertaken of this major European multi-hazard challenge for decision makers responsible for the safety of the population, as well as visitors, and mindful of the economic consequences of business disruption.	Journal of Applied Volcanology	Geohazards Community and decision makers	W.P. Aspinall and G.Woo	ASPINAL L	Planned	2014
Weighing the importance of model uncertainty against parameter uncertainty in earthquake loss assessments.	Epistemic uncertainties can be classified into two major categories: parameter and model. While the first one stems from the difficulties in estimating the values of input model parameters, the second comes from the difficulties in selecting the appropriate type of model. Investigating their combined effects and ranking each of them in terms of their influence on the predicted losses can be useful in guiding future investigations. In this context, we propose a strategy relying on variance-based global sensitivity analysis, which is demonstrated using an earthquake loss assessment for Pointe-Pitre (Guadeloupe, France). For the considered assumptions, we show: that uncertainty of losses would be greatly reduced if all the models could be unambiguously selected; and that the most influential source of uncertainty (whether of parameter or model type) corresponds to the seismic activity group. Finally, a sampling strategy was proposed to test the influence of the experts' weights on models and on the assumed coefficients of variation of parameter uncertainty. The former influenced the sensitivity measures of the model uncertainties, whereas the latter could completely change the importance rank of the uncertainties associated to the vulnerability assessment step.	Soil Dynamics and Earthquake Engineering	Academic researchers, engineers	Jeremy Rohmer, John Douglas, Didier Bertil, Daniel Monfort Climent, Olivier Sedan	BRGM	In review	unknown
Short summary of the 2 nd MATRIX Stakeholder Workshop	Centre for Climate and Safety (CCS) of the Karlstad University confirmed to write a summary of the 2 nd MATRIX Stakeholder Workshop and to put a link to the English version of the MATRIX article available at: http://matrix.gpi.kit.edu/Downloads.php	CCS Website	To be confirmed	To be confirmed	CCS	Planned	2013

Title of Publication	Short Description	Publisher	Readership	Author(s)	Contrib. Partners	Status	Publication Date (expected)
MATRIX: Ein EU-Projekt zur Abschätzung multipler Gefahren	General description of MATRIX objectives and the incentive to involve National Platforms for DRR Available also online: http://www.dkkv.org/DE/publications/default.asp?h=2	DKKV, Annual Report 2010	Scientific and operative members of DKKV, interested population and organisations	R. Mrzyglocki	DKKV	Published	July 2011
MATRIX-Forschungsprojekt: DKKV fördert Austausch zwischen Forschung und Praxis	The article describes the interactions with the National Platforms in the framework of MATRIX. Available also online: http://www.dkkv.org/DE/publications/default.asp?h=2	DKKV , Annual Report 2012	Scientific and operative members of DKKV, interested population and organisations	R. Mrzyglocki	DKKV	Published	July 2013
IRDR, Annual Report 2011	Integrated Research on Disaster Risk (IRDR). Short description of MATRIX objectives and the incentive to involve National Platforms for DRR Available also online: http://www.irdrinternational.org/wp-content/uploads/2012/07/Annual-Report-2011.pdf	IRDR	Scientific community	R. Mrzyglocki	DKKV	Published	July 2012
IRDR, Annual Report 2012	Integrated Research on Disaster Risk (IRDR). General description of MATRIX objectives and the incentive to involve National Platforms for DRR Available at: http://www.irdrinternational.org/wp-content/uploads/2013/05/2012-Annual-Report-FINAL_web.pdf	IRDR	Scientific community	R. Mrzyglocki	DKKV	Published	May 2013
MATRIX - neue Methoden und Werkzeuge für multiple Risiken	An Article for the purpose of dissemination with general information about MATRIX and its expected outcomes. It highlights the importance of a close cooperation between National Platforms / Civil Protection Authorities and the science. Available also online:	The Federal Office of Civil Protection and Disaster Assistance. 2/2013	Civil Protection, Humanitarian Aid	R. Mrzyglocki A. Mignan	DKKV, ETH Zurich	Published	May 2012

Title of Publication	Short Description	Publisher	Readership	Author(s)	Contrib. Partners	Status	Publication Date (expected)
	http://www.bbk.bund.de/SharedDocs/Downloads/BBK/DE/Publikationen/Publ_magazin/bsmag_2_13.pdf?blob=publicationFile	"Bevölkerungsschutz" magazine					
The Ministry of Life - Austria	An Article for the purpose of dissemination with general information about MATRIX and its expected outcomes. It highlights the importance of a close cooperation between National Platforms / Civil Protection Authorities and the science.	www.naturgefahren.at	Disaster Managers	R. Mrzyglocki, A. Mignan	DKKV, ETH Zurich	Published	July 2013
To be confirmed	An Article for the purpose of dissemination with general information about MATRIX and its expected outcomes. It highlights the importance of a close cooperation between National Platforms / Civil Protection Authorities and the science. It is planned to publish an Italian version.	Italian Civil Protection Department (DPC)	Civil Protection	R. Mrzyglocki, A. Mignan	DKKV, ETH Zurich	Planned	Summer issue of the DPC magazine 2013
The Quantification of Low Probability-High Consequences Events: Part I. A Generic Multi-Risk Approach	Dynamic risk processes have yet to be clearly understood and properly integrated into probabilistic risk assessment. While much attention has been given to this aspect lately, most studies remain limited to specific multi-risk scenarios. We present a generic probabilistic framework based on the sequential Monte Carlo method to implement coinciding events and triggered chains of events, as well as time-dependent vulnerability and exposure. We consider generic perils based on analogies with real ones, natural and man-made. Each simulated time series corresponds to one risk scenario and the analysis of multiple time series allows for the probabilistic assessment of losses and for the recognition of more or less probable risk paths, including extremes or low-probability high-consequences chains of events. We find that "black swans", which commonly refer to unpredictable outliers, can be captured by adding more knowledge on potential interaction processes by using a brick-by-brick approach. We introduce the concept of risk migration matrix to evaluate how multi-risk participates in the emergence of extremes and we show that risk migration and risk amplification are the two main causes	Natural Hazards	Scientific and operational disciplines for hazard mitigation	Mignan, A., S. Wiemer and D. Giardini	ETH Zürich	submitted	unknown

Title of Publication	Short Description	Publisher	Readership	Author(s)	Contrib. Partners	Status	Publication Date (expected)
	for their occurrence.						
Uncertainty and sensitivity analyses in seismic risk assessments on the example of Cologne, Germany	This work involved an uncertainty and sensitivity analyses in seismic risk assessment for the city of Cologne, a MATRIX test case. Uncertainties (both aleatory and epistemic) are present at each step of the seismic risk assessment process, all contributing to the total uncertainty, which might be very high. This influences decision making as it could lead to either very conservative and expensive decisions or the perception of considerable risk. It is therefore important to propagate the different individual uncertainties through the computational chain and to quantify their contribution to the total value of risk. This study employed a logic tree approach, emphasising epistemic uncertainties, which are reducible. A sensitivity analysis of the resulting seismic risk assessments with regards to the different uncertainty sources was carried out.	Natural hazard and Earth System Sciences	Seismologists, seismic hazard assessment engineers	S. Tyagunov, M. Pittore, M. Wieland, S. Parolai, K. Fleming, J. Zschau	GFZ	Submitted	Under revision
The co-production of scientific advice and decision making under uncertainty: lessons from the 2009 L'Aquila earthquake, Italy	On 22 October 2012 seven members of the Italian Major Risk Commission were found guilty of 29 person's manslaughter and of 4 injuries in relation with the earthquake that hit L'Aquila, a town in Central Italy, in the year 2009. The members were verdict to six years in prison for violating their obligations to adequately analyse seismic risk and to provide clear, correct and complete information, which might have saved many people's life. The case has not been concluded yet and so far the debate focused on the scientific, legal and communicative aspects of the verdict, while the institutional ones, including the co-production of scientific advice and decision making, received less attention. We argue that the presence of deep epistemic uncertainty coupled with responsibility overlaps of scientists-turned-decision-makers, is fundamental to understanding the event and the legal aftermath. Another relevant institutional aspect is the concern of the national and local authorities that the population would over-react to anything other than a reassuring message. We discuss the consequences of this framing of the emergency management	Planet @ risk, State of the Art Collection category – Working paper section		Anna Scolobig, Reinhard Mechler, Nadejda Komendantova, Liu Wei, Dagmar Schröter, Anthony Patt	IIASA	Submitted	July 2013

Title of Publication	Short Description	Publisher	Readership	Author(s)	Contrib. Partners	Status	Publication Date (expected)
	<p>problem in terms of public control rather than public safety. As risk science continues to grapple with the challenge of communicating uncertain information to decision-makers and citizens, it becomes more important to understand the co-production processes that shape how scientific advice is used for decisions on the ground.</p>						
<p>Time dependency: Social and Economic Vulnerability</p>	<p>We investigate the question about short and medium term consequences due to natural disaster events and respective time-dependencies. Consequences are estimated by comparing the actual economic performance with a counterfactual projected one using an econometric approach. Time-dependencies and multi risks come into play via suitable selections of indicators based on past events from relevant databases. It is found that no general conclusions about the combined (integrated) effects over some years due to disasters can be given without any information of the resilience of the system which is shocked. In other words, there can be no, positive as well as negative long term effects experienced depending on the resilience of the system before the shock. Importantly, resilience itself was treated as path dependent and therefore included past experiences in disaster events for the respective cases. Regarding the question as to which variables could explain socio-economic resilience dimensions the most it was found that not only loss dimensions play a significant role, but also the path of resilience in the past which led to the pre-disaster situation as well as the possibilities of multi hazard situations.</p>	<p>Proceedings: Conference Dealing with Disasters, Northumbria University, 4 – 6 September, Newcastle upon Tyne, UK.</p>	<p>Scientific community and general public interested in the area.</p>	<p>Hochrainer-Stigler, S.</p>	<p>IIASA</p>	<p>Forthcoming</p>	<p>December 2013</p>
<p>The Costs and Benefits of Reducing Risk from Natural Hazards to Residential Structures in</p>	<p>This paper examines the benefits and costs of improving or retrofitting residential structures in highly exposed low- and middle-income developing countries such that they are less vulnerable to hazards during their lifetime. Since it is misleading to assess the benefits of prevention using deterministic models, the challenges for cost benefit analyses are to express avoided losses in probabilistic terms, evaluate</p>	<p>Risk Analysis</p>	<p>Policy makers, scientists</p>	<p>Hochrainer-Stigler, S., Kunreuther, H., Linnerooth-Bayer, J., Mechler, R., Michel-Kerjan,</p>	<p>IIASA</p>	<p>Published</p>	<p>January 2011</p>

Title of Publication	Short Description	Publisher	Readership	Author(s)	Contrib. Partners	Status	Publication Date (expected)
Developing Countries	and assess risk, monetize direct and indirect benefits and include dynamic drivers such as changing population, land use and climate. In detail, we examine structures exposed to three different hazards in four countries, including hurricane risk in St. Lucia, floodrisk in Jakarta, earthquake risk in Istanbul and flood risk within the Rohini River basin in Uttar Pradesh (India). The purpose in undertaking these analyses is to shed light on the benefits and costs over time, recognizing the bounds of the analysis, and to demonstrate a systematic probabilistic approach for evaluating alternative risk reducing measures.			E., Muir-Wood, R., Ranger, N., Vaziri, P., Young, M.			

Title of Publication	Short Description	Publisher	Readership	Author(s)	Contrib. Partners	Status	Publication Date (expected)
Catastrophe Risk Models for Evaluating Disaster Risk Reduction Investments in Developing Countries	Major natural disasters in recent years have had high human and economic costs, and triggered record high post disaster relief from governments and international donors. Given the current economic situation worldwide, selecting the most effective disaster risk reduction (DRR) measures is critical. This is especially the case for low- and middle-income countries, which have suffered disproportionately more economic and human losses from disasters. This paper discusses a methodology that makes use of advanced probabilistic catastrophe models to estimate benefits of DRR measures. We apply such newly developed models to generate estimates for hurricane risk on residential structures in the island of St. Lucia, and earthquake risk on residential structures in Istanbul, Turkey as two illustrative case studies. The costs and economic benefits for selected risk reduction measures are estimated taking account of hazard, exposure and vulnerability. We conclude by emphasizing the advantages and challenges of catastrophe model-based cost-benefit analyses for DRR in developing countries.	Risk Analysis, 33(6): 984-999. DOI: 10.1111/j.1539-6924.2012.01928.x	Policy makers, scientists	Michel-Kerjan, E., Hochrainer-Stigler, S., Kunreuther, H., Linnerooth-Bayer, Mechler, R., Muir-Wood, R., Ranger, N., Vaziri, P., Young, M.	IIASA	Published	December 2012
Probabilistic cost-benefit analysis of disaster risk management in a development context	Limited studies have shown that disaster risk management (DRM) can be cost-efficient in a development context. Cost-benefit analysis (CBA) is an evaluation tool to analyse economic efficiency. This research introduces quantitative, stochastic CBA frameworks and applies them in case studies of flood and drought risk reduction in India and Pakistan, while also incorporating projected climate change impacts. DRM interventions are shown to be economically efficient, with integrated approaches more cost-effective and robust than singular interventions. The paper highlights that CBA can be a useful tool if certain issues are considered properly, including: complexities in estimating risk; data dependency of results; negative effects of interventions; and distributional aspects. The design and process of CBA must take into account specific objectives, available information, resources, and the perceptions and needs of stakeholders as transparently as	Disasters, 37: 374–400. DOI: 10.1111/disa.12002	academics, policymakers and practitioners	Kull, D., Mechler, R., Hochrainer, S.	IIASA	Published	April 2013

Title of Publication	Short Description	Publisher	Readership	Author(s)	Contrib. Partners	Status	Publication Date (expected)
	possible. Intervention design and uncertainties should be qualified through dialogue, indicating that process is as important as numerical results.						
Inter-Related Effects due to Droughts for Rural Populations A Qualitative Field Study for Farmers in Iran	The paper provides in-depth information on the multiple realities and time-dependencies during drought events over different sub-groups of an affected society. Dynamics are analysed based on categorization of impacts into human, social, financial and natural capital effects and using the conservation of resources theory for the behavioural explanation of selected coping strategies. A qualitative field study based on this approach was conducted in a village in southern Iran. It was found that drought events can cause waves of negative effects on various capital dimensions to farmers, especially for the poor. The dimensions are very much interrelated and can multiply negative effects, decreasing resilience to drought to such low levels that this eventually can lead to poverty trap-like situations. Furthermore, it was found that government aid interventions unintentionally worsened the situation of the poor. To avoid such situations it is suggested to shift from relief or ex-post interventions to a proactive risk management approach.	International Journal of Mass Emergencies and Disasters	Scientific community and general public interested in the area.	Monfared, N., Yazdanpanah, M, and Hochrainer-Stigler, S.	IIASA	Forthcoming	October 2013
Does disaster risk management pay?	The toll from natural disasters, such as floods, landslides, cyclones, earthquakes, and tsunamis is increasing, as populations rise and more assets are at risk. At the same time climate change is changing the frequency and intensity of climate-related events. While researchers cannot predict the precise location and timing of disastrous events, they can estimate the risk of such events. Researchers in IIASA's Risk, Policy, and Vulnerability program are working to determine actions pay off, and how countries and local governments can make smart investment decisions that lead to fewer deaths and less destruction.	Options	Policy makers, scientists	Reinhard Mechler, Stefan Hochreiner-Stiegler, Nadejda Komendantova	IIASA	Published	2013
Addressing	The analysis of barriers in the governance systems of two	International		Komendantova,	IIASA	In	

Title of Publication	Short Description	Publisher	Readership	Author(s)	Contrib. Partners	Status	Publication Date (expected)
Multiple Risks of Natural Hazards in Different Systems of Risk Governance.	countries for the implementation of a multi-risk approach, comparing more centralized and decentralized governance systems.	Relations and Diplomacy Journal		N., Scolobig, A., Vinchon, C.		preparation	
Multi-risk governance for natural hazards in Napoli and Guadeloupe	<p>Technical and institutional capacities are strongly related and must be jointly developed to guarantee effective natural risk governance. Indeed, the available technical solutions and decision support tools influence the development of institutional frameworks and disaster policies. This paper analyses technical and institutional capacities, by providing a comparative evaluation of governance systems in Italy and France. The focus is on two case studies: Napoli and Guadeloupe. Both areas are exposed to multiple hazards, including earthquakes, volcanic eruptions, landslides, floods, tsunamis, fires, cyclones, and marine inundations. The research design grounds on a documentary analysis of laws and policy documents informed by semi-structured interviews and focus groups with stakeholders at the local level. This leads to identify three sets of governance characteristics that cover the key issues of: i) stakeholders and governance level; ii) decision-support tools and mitigation measures; and iii) stakeholder cooperation and communication. The results provide an overview of similarities and differences as well as strengths and weaknesses of the governance systems across risks. Both case studies have developed adequate decision support tools for most of the hazards. Warning systems, and assessments of hazards and exposure are the main strengths. While technical/scientific capacities are very well developed, the main weaknesses are the interagency communication and cooperation, and the use and dissemination of scientific knowledge in developing policies and practices.</p>	Natural Hazards	Scientific and operational disciplines for hazard mitigation	Anna Scolobig, Nadejda Komendantova, Anthony Patt, Charlotte Vinchon, Daniel Monfort-Clement, Mendy Begoubou-Valerius, Paolo Gasparini, Angela di Ruocco	IIASA, BRGM AMRA	Submitted	August 2013

Title of Publication	Short Description	Publisher	Readership	Author(s)	Contrib. Partners	Status	Publication Date (expected)
Generic Multi-Risk Model and Decision-Support Tool for Mitigation of Multiple Natural Hazards.	<p>Current multiple hazards disasters such as the 2004 Sumatra-Andaman earthquake and the 2011 Tohoku earthquake showed the need of multi-risk approach in assessment, mitigation and management. However, as historical and real case studies show, individual hazards are treated separately by scientists, engineers, civil protection authorities, which leads to ignorance of spatial, temporal and causal relationships and consequences of risks interactions. The European policy-making process foresees implementation of the multi-risk approach. The Hyogo Framework for Action tells that research methods and tools for multi-risk assessments should be developed and strengthened (UN/ISDR, 2005). The Council of the European Union underlines the usefulness of a multi-hazard approach to a Community disaster prevention framework. However, the question is how multi-risk assessment tools can support decision-making process given existing institutional frameworks and what are the perceptions of civil protection community of the usability of these tools? These questions can be approached in the framework of the risk governance concept. It tells that for multi-risk approach we need to understand how information is collected, perceived and communicated and management decisions are taken (IRGC, 2005) and we need to examine also the frameworks employed in the field of risk management, as well as the interactions between science and practice in terms of knowledge transfer and the applicability of results (Kappes et al., 2011). The recommendations from our work include results from interaction with stakeholders in civil protection authorities in 15 European countries through a row of stakeholders workshops conducted in different countries. They provide insights on usefulness of the decision-support tools for understanding of losses and communication of multi-risk parameters.</p>			Komendantova, N., Mrzyglocki, R., Mignan, A., Khazai, B., Wenzel, F., Patt, A., Fleming, K.	IIASA, DKKV	Submitted	2013
Evaluating stakeholder perceptions in	The slow transfer from theory to practice might lay in the difficulties of the communication process from science to policy-making, including perceptions by stakeholders from	International Journal of Disaster Risk	researchers, policymakers and	Nadejda Komendantova, PhD; Roger	IIASA, DKKV, ETH Zurich,	Submitted	2013

Title of Publication	Short Description	Publisher	Readership	Author(s)	Contrib. Partners	Status	Publication Date (expected)
multi-hazard and multi-risk decision support models	disaster mitigation practice regarding the usability of developed tools. As scientific evidence shows, decision-makers are faced with the challenge of not only mitigating against single hazards and risks, but also multiple risks, which must include the consideration of their interrelations. In this article we identify perceptions of two decision making tools, which involve multi-hazard and multi-risk. The first one is a generic, multi-risk framework based on the sequential Monte Carlo method to allow for a straightforward and flexible implementation of hazard interactions, which may occur in a complex system. The second is a decision-making tool that integrates directly input from stakeholders by attributing weights to different components and constructing risks ratings. Based on the feedback from stakeholders, we found that interest in multi-risk assessment is high but that its application remains hampered by the complexity of processes involved.	Reduction	practitioners across diverse disciplines: Earth Sciences in its entirety; Environmental Sciences; Engineering; Urban Studies; Geography; and Social sciences	Mrzyglocki; Arnaud Mignan, PhD; Bijan Khazai , PhD; Friedemann Wenzel, Prof.; Kevin Fleming, PhD	KIT, GFZ		
Wildfire Risk Analysis.	Extreme wildfires (high intensity $>2700\text{kW m}^{-1}$) are adverse events that are the focus of wildfire risk analysis. As a consequence of high-intensity wildfires, there are different phenomena involved: smoke in the convection column, embers from spotting, and flames in the fire front. These different phenomena have different impacts on the various elements at risk (e.g., people, houses, trees). To minimize the risk, it is important to predict the spatial distribution of wildfire hazard, which can be seen as the probability that a wildfire affects a certain area during a certain period of time. There are thus two dimensions of wildfire hazard, spatial and temporal, that are usually analysed separately. The other component to minimize is the vulnerability of the different elements at risk. The total wildfire risk can thus be computed as the probability of a wildfire to occur multiplied by the estimated total losses.	Encyclopaedia of Environmetrics	Scientific community and general public interested in the area.	Rego, F.C., Colaço, M.C.	ISA-CEABN	Published	2013
Proposal for a model to	The paper proposes a model to quantify both these effects. The model is based on an infinite slope formulation where	Geophysical Research	Academic researchers,	Vangelsten, B.V., Liu, Z., Eidsvig, U.,	NGI	Published	April 2013

Title of Publication	Short Description	Publisher	Readership	Author(s)	Contrib. Partners	Status	Publication Date (expected)
assess the effect of seismic activity on the triggering of debris flows	precipitation and earthquakes influence the slope stability as follows: (1) During the shaking, the factor of safety is reduced due to cyclic pore pressure build-up where the cyclic pore pressure is modelled as a function of earthquake duration and intensity (measured as number of equivalent shear stress cycles and cyclic shear stress magnitude) and in-situ soil conditions (measured as average normalised shear stress). The model is calibrated using cyclic triaxial and direct simple shear (DSS) test data on clay and sand. (2) After the shaking, the factor of safety is modified using a combined empirical and analytical model that links observed earthquake induced changes in rainfall thresholds for triggering of debris flow to an equivalent reduction in soil shear strength.	Abstracts	engineers	Quan Luna, B., and Nadim, F.			
Regional scale landslide risk assessment with a dynamic physical model - development, application and uncertainty analysis	This paper presents a medium-scale, dynamic physical model for rapid mass movements in mountainous and volcanic areas. The deterministic nature of the approach makes it possible to apply it to other sites since it considers the frictional equilibrium conditions for the initiation process, the rheological resistance of the displaced flow for the run-out process and fragility curve that links intensity to economic loss for each building. The model takes into account the triggering effect of an earthquake, intense rainfall and a combination of both (spatial and temporal). The run-out module of the model considers the flow as a 2-D continuum medium solving the equations of mass balance and momentum conservation. The model is embedded in an open source environment geographical information system (GIS), it is computationally efficient and it is transparent (understandable and comprehensible) for the end-user.	Geophysical Research Abstracts	Academic researchers, engineers	Quan Luna, B., Vangelsten, B.V., Liu, Z., Eidsvig, U., and Nadim, F.	NGI	Published	April 2013
Landslides induced by the interaction of an earthquake and subsequent	The consideration of multiple hazards and their interaction to achieve risk reduction is a necessity since many regions are prone to different types of threats. However, this is neither simple and straightforward nor commonly undertaken at present since different natural hazards are usually analysed individually and managed separately. A common example of	Proceedings of the 18th International Conference on Soil Mechanics and	Academic researchers, engineers	Quan Luna, B., Vangelsten, B.V., Liu, Z., Eidsvig, U., and Nadim, F.	NGI	In review	September 2013

Title of Publication	Short Description	Publisher	Readership	Author(s)	Contrib. Partners	Status	Publication Date (expected)
rainfall. A spatial and temporal model	this is the alteration of the density and locations of rainfall-induced landslides after an earthquake due to the extensive disturbance of surface strata. That implies an influence of the earthquake on the soil structure that alters the disposition towards landslides. Taking this into consideration, a model was developed that could give a rough spatial and temporal prediction of expected change in landslide hazard in an area following an earthquake. The model is able to describe the reduced impact of earthquakes with distance from epicentre as well as how the soil gradually regains its strength with time. These reductions are then applied to an equilibrium stability analysis in order to compute new Factors of Safety. Although analysis schemes can be proposed and software tools can be provided to facilitate many steps, a well-conceived and reflective approach to multi-hazard settings is still essential.	Geotechnical Engineering, Paris 2013					
Quantitative risk assessment for earthquake-triggered landslides using Bayesian network	Strong earthquakes in mountainous regions usually trigger many landslides that lead to damage and destruction. Separate investigations of single hazard processes (earthquake and landslide) might lead to a misjudgement of the risks associated with this type of cascading hazards. The assessment and mitigation of the risks require a multi-risk analysis approach that can account for the interactions among the threats and among the vulnerabilities to these threats. In this paper, a quantitative risk assessment model using Bayesian network is proposed to estimate the risk for the buildings exposed to the threat of earthquake-triggered landslides. A sensitivity analysis was done to identify the optimum and appropriate risk reduction strategy in a multi-hazard perspective.	Proceedings of the 18th International Conference on Soil Mechanics and Geotechnical Engineering, Paris 2013	Academic researchers, engineers	Nadim, F. Liu, Z.	NGI	In review	September 2013
Uncovering the Specific Product Rule for the Lattice of	We give here the specific product rule for the lattice of questions. This product rule differs from the product rule for the lattice of statements, hence the qualifier 'specific'. This is because the elements in the lattice of statements are ordered	Cornell University Library, Ithaca 2013	Academic researchers, Methodology	van Erp, H.R.N.	TU Delft	Published	02. September 2013

Title of Publication	Short Description	Publisher	Readership	Author(s)	Contrib. Partners	Status	Publication Date (expected)
Questions	by way of implication, an upper context, whereas the elements in the lattice of questions are ordered by way of relevancy, a lower context.						
A three-level approach based framework for consistent multi-risk assessment	This paper summarizes previous research on multi-risk assessment and proposes a new three-level framework for multi-risk assessment that could account for possible interactions among threats. The first level is a simple flow chart that guides the user in whether a multi-hazard, multi-risk approach is required for the problem at hand. The second level is a simplified, qualitative approach to explore further the need for a detailed assessment. The third level is a detailed quantitative multi-risk analysis based on Bayesian networks. The key components of this framework, such as cascade hazards assessment, time-dependent vulnerability estimation, and the choice of the required level of sophistication are addressed. The multi-risk assessment procedure outlined in the paper integrates the results of risk posed by each threat, cascade effect, and appropriate consideration of uncertainties, to provide a more rational estimate of multiple risks. Simple examples that demonstrate the application of the method are presented in the paper.	Proceedings of the 4th International Symposium on Geotechnical Safety and Risk, Hong Kong 2013	Academic researchers, engineers	Liu, Z., Nadim, F.	NGI	In review	December 2013
Quantitative multi-risk assessment using Bayesian network	A new quantitative approach for multi-risk assessment using Bayesian network that could account for the possible interactions among the threats was proposed in this paper. The multi-risk assessment procedure outlined in the paper integrates the results of risk posed by each threat, cascade effect, and appropriate consideration of uncertainties, to provide a more rational estimate of multiple risks. The earthquake triggered landslide scenario that demonstrates the application of the method based on the Virtual-City software tool being developed within the MA-TRIX project as part of the more general MATRIX-CITY platform are presented in the paper.		Academic researchers, engineers	Liu, Z., Nadim, F., Vangelsten, B.V., Eidsvig, U., and Quan Luna, B.	NGI	Planned	October 2013

Appendix 3 – Interactions with and results to DMC and other communities (chronological)

Date	Type of interaction	Short Description	Target group	Organiser(s)
December 2010	Cooperation Request Letter	Official request for cooperation to involve National Platforms for DRR to cooperate within MATRIX and give advice with regard to its development	National Platforms / Civil Protection Authorities	GFZ / DKKV
February 2 of 2011, Portugal	Field work to visit the burned forest area in Mação after the 2003 Wildfires	Field work to visit the burned forest area in Mação after the 2003 Wildfires by Conceição Colaço	Foresters	ISA-CEABN
8-11 February 2011, Madeira, Portugal	V Forest Macaronesia Journeys	Presentation of the MATRIX project by Francisco Rego	Scientific Community	ISA-CEABN
April 2011	MATRIX fact sheet	General Dissemination Material to National Platforms for DRR	National Platforms / Civil Protection Authorities	KIT / DKKV
3 - 8 April 2011 Vienna, Austria	European Geosciences Union (EGU) meeting F. Wenzel (KIT)		Geoscientists	KIT
3 - 8 April 2011 Vienna, Austria	EGU General Assembly Poster presentation "MATRIX: Developing multi-hazard and multi-risk assessment methods for Europe"	Outline of the MATRIX project, the context within it is being conducted, the planned activities and hoped for outcomes	Hazard and risk researchers	GFZ, AMRA, BRGM
28 April 2011 Brussels, Belgium	ECHO Expert meeting on early warning in Europe	General outline of the MATRIX project	National Platforms, policy makers, civil protection	GFZ

Date	Type of interaction	Short Description	Target group	Organiser(s)
2-4 May 2011, Technical University of Braunschweig, Germany	Paper submitted and presented at the 18th CIRP International Conference on Life Cycle Engineering			TU Delft
1-7 May 2011, Italy	Discussion with researchers of the University Federico II in Naples	Discussion with researchers of the University Federico II in Naples. Naples as a case study on multiple natural hazards by Francisco Rego	Scientific Community	ISA-CEABN
10-11 May 2011 Orléans, France	S. Laskowski (KIT) EU project ENSURE Final workshop	Taking part in a Round Table discussion to present recently started EU projects in the context of Natural Hazards	ENSURE consortium, invited participants of other EU projects	KIT
11 July 2011. Brussels, Belgium	ECHO Expert meeting on risk assessment and disaster management	General outline of the MATRIX project.	Disaster managers, researchers, policy makers	GFZ
3-4 October 2011, Sardinia, Italy	International Conference on Fire Behaviour and Risk	Presentation of the MATRIX project by Francisco Rego	Scientific Community	ISA-CEABN
10-12 October 2011, 1 st Paris, France	MATRIX Annual General Assembly Various persons from other EU projects, national platforms and the OECD- GSF.	Annual MATRIX General Assembly, report on the project, with presentations from other projects and national representatives.	Representations of national platforms, other relevant projects.	GFZ, AMRA, BRGM, and the MATRIX consortium
17-18 November 2011 Leipzig, Germany	MATRIX represented at the closing meeting of the EU CONHAZ project.	CONHAZ set out to develop methods for the cost assessment of damage, prevention and responses to natural hazards, in order to supply crucial information to decision support and policy development.	Hazard and risk researchers, policy makers.	GFZ

Date	Type of interaction	Short Description	Target group	Organiser(s)
23-25 November 2011, Bratislava, Slovakia	EGU 2011 Leonardo Conference, MATRIX members present at this meeting.	Floods in 3D: Processes, Patters, Predictions	Flood hazard and risk research community	GFZ
5 – 9 December, 2011, San Francisco, USA	AGU Fall Meeting. Poster presentation “Multi-Hazard and Multi-Risk Assessment MethodS for Europe (MATRIX): A research program towards mitigating multiple hazards and risks in Europe”	General outline of the MATRIX project, in particular noting the primary activities and issues associated with multi-hazard and risk.	Hazard and risk researchers	GFZ, AMRA, BRGM
9 January 2012 Brussels, Belgium	Meeting of the Global Earthquake Model initiative (presentation).	Aspects of the MATRIX project relevant to the discussion dealing with possible future directions were presented.	Stakeholders (World bank, UN), policy makers, researchers, civil protection, national platforms.	GFZ
February 28 to March 1 of 2012 and 13-20 March 2012, Portugal	Interaction with WP5. Field work to visit the burned houses in Vila de Rei, Mação and Chamusca after the 2003 Wildfires.	Field work to visit the burned houses in Vila de Rei, Mação and Chamusca after the 2003 Wildfires by Conceição Colaço and Liliana Bento	Local authorities, Civil Protection and population	ISA-CEABN
March 2012	Workshop Concept Note	Concept Note: MATRIX Tools for Multi-Risk Scenarios - describing the MATRIX and the MATRIX-Tools	European National Platforms for DRR and Civil Protection Authorities	KIT / DKKV / ETH Zurich / GFZ
23-26 March 2012, London, UK		N. Komendantova, A. Patt (IIASA) Planet Under Pressure Conference		IIASA

Date	Type of interaction	Short Description	Target group	Organiser(s)
March 2012, German Research Institute for Public Administration Speyer Speyer, Germany	N. Komendantova, A. Patt, A. Scolobig (IIASA) Paper submitted and accepted for peer-review publication and presentation at the conference	Converging and Conflicting Trends in the Public Administration of the US, Europe, and Germany		IIASA
14-16 March 2012, Milan, Italy	Presentation of the MATRIX project to the “Integrated Risk Workshop”, Regione Lombardia	General outline of the MATRIX project	Hazard and risk researchers, policy makers, disaster managers and responders	GFZ
07-12 April 2013	EGU 2013	Managing disaster risks. Press conference. Reinhard Mechler, Stefan Hochrainer-Stiegler, Nadejda Komendantova	Geoscientists	IIASA
10-13 April 2012, Portugal	Interaction with WP4. Field work to visit the burned houses in Monchique after the 2003 Wildfires	Field work to visit the burned houses in Monchique after the 2003 Wildfires by Conceição Colaço	Local authorities, Civil Protection and population	ISA-CEABN
22 – 27 April 2012, Vienna, Austria	, EGU General Assembly 2012 Conference session “Multi-type hazard and risk assessment”	Session concerned with the assessment of multi-type hazards and risks, focusing on the propagation of uncertainties, cascade (domino) effects, time-dependency, and case studies	Hazard and risk researchers	GFZ, AMRA, BRGM
22 - 27 April 2012, Vienna, Austria	EGU General Assembly 2012, Poster presentation “Seismic Hazard and Risk	Outline of the tasks implemented by GFZ in the MATRIX project, including those related to the WP2, WP3 and WP7, for the	Hazard and risk researchers	GFZ

Date	Type of interaction	Short Description	Target group	Organiser(s)
	Assessment in Multi-Hazard Prone Urban Areas: The Case Study of Cologne, Germany”	study area of Cologne		
22-27 April 2012	EGU2012	Comparative risk assessments for the city of Pointe-à-Pitre (French West Indies): earthquakes and storm surge Arnaud Réveillère, Didier Bertil, John Douglas, Ludovic Grisanti, Sophie Lecacheux, Daniel Monfort, Hormoz Modaressi, Héloïse Muller, Jérémy Rohmer, Olivier Sedan	Geoscientists	BRGM
Mai 2012	Questionnaire	A questionnaire was submitted to all involved National Platforms. The questionnaire covered the following topics: understanding of multi-risk, availability of hazard and risk assessments, types of hazard and risk assessments, usage of assessment results in decision making, applied methods, multi-risk and its integration into own work environment, multi-risk requirements, advantages of multi-risk, barriers in implementation	National Platforms	DKKV / KIT / IIASA
7-9 June 2012 Madeira, Portugal	I Laurissilva Congress	Presentation of the MATRIX project by Francisco Rego	Scientific Community	ISA-CEABN
12-14 June 2012, Tunisia	EFIMED Week 2012	Presentation of the MATRIX project by Francisco Rego	Scientific Community	ISA-CEABN
14 -15 June 2012, New Zealand	“ Rural fire research Workshop”	Presentation of the MATRIX project by Conceição Colaço	Scientific Community, forest and fire managers and civil defence from New Zealand and Australia	ISA-CEABN

Date	Type of interaction	Short Description	Target group	Organiser(s)
12-14 June 2012	Génie Civil Génie Côtiers	Etude probabiliste de l'aléa submersion marine lié aux cyclones en Guadeloupe : analyse des vagues Cherbourg, France: Sophie Lecacheux, Héloïse Muller, Rodrigo Pedreros, Jérôme Thiébot, Jehane Ouriqua, Arnaud Reveillère	-	BRGM
April 21 to June 26 2012, New Zealand	Interactions with WP4	Field work and research in the WP4: Task 4.3 "Wildfire Social Vulnerability" by Conceição Colaço	Researchers, communities, civil defence, forest and fire managers	ISA-CEABN
5/6 July 2012, Bonn, Germany	1 st MATRIX Stakeholder Workshop	MATRIX Tools for Multi-Risk Scenarios: The aim of the workshop was to: capture the status of, different approaches to, and open problems with regard to multi-risk assessment in Europe and understand the users' requirements with regard to information technology for the generation of scenarios. Understand the range of risk components addressed in the current practise (losses to people's health and lives, economic losses, ecological losses, losses to infrastructure and critical infrastructure, intangible losses).	European National Platforms for DRR and Civil Protection Authorities	DKKV / KIT / GFZ
17-20 July 2012, Portugal	Interaction with WP4. Presentation of the MATRIX project to the local community of Chamusca and Mação	Presentation of the MATRIX project and discussion with the local authorities, Civil Protection and with the community about the vulnerability to wildfires by Conceição Colaço.	Local authorities, Civil Protection and population	ISA-CEABN
19-20 July 2012	International conference on Converging and conflicting trends in the	Institutional challenges for multi-risk governance: comparative analysis of two case studies. Nadejda Komendantova,		IIASA / BRGM

Date	Type of interaction	Short Description	Target group	Organiser(s)
	public administration of the US, Europe and Germany	Anna Scolobig, Charlotte Vinchon, Mendy Begoubou-Valerius, Anthony Patt		
14. September 2012	Workshop feedback sheet	Feedback received on the 1 st MATRIX-Stakeholder Workshop from all participating National Platforms / Civil Protection Authorities. The workshop dealt with quality of presentations, impact on further MATRIX research activities, organizational issues and the perceptions of the stakeholders with regard to multi-risk.	National Platforms / Civil Protection Authorities	DKKV / KIT
24-28 September 2012	WCEE, Lisbon	Development of seismic fragility curves for damaged reinforced concrete structures main shock-damaged reinforced-concrete structures. A. Réveillère, P. Gehl, D. Seyedi & H. Modaressi		BRGM
3-7 October 2012, Greece	6 th Conference of the Hellenic Ecological Society	Presentation of the MATRIX project by Francisco Rego.	Scientific Community	ISA-CEABN
17-19 October 2012, Lisbon	Workshop	12th PPRD South "Prevention and preparedness" workshop for staff-level officials - "Multi-hazard risk assessment in urban environment". The objective of the 3-day workshop was twofold: educate in the field of multi-hazard and multi-risk assessment and present the state-of-the-art research developed in recent and ongoing EU projects. MATRIX CITY platform was presented and an exercise on multi-	staff-level officials	ETH Zürich

Date	Type of interaction	Short Description	Target group	Organiser(s)
		hazard based on the methodology developed in MATRIX CITY conducted		
October 18-19, 2012, GEORISK-2012, Moscow, Russia	Proceedings publication "Natural Multi-Risks: Problems and Methods of Holistic Assessment."	A paper published in Proceedings of Int. Sci.-Pract. Conf.: Problems of Decrease of Natural Hazards and Risks. GEORISK-2012, October 18-19, 2012, Moscow, Peoples' Friendship University of Russia, Vol.2, pp.78-82. (in Russian)		GFZ
22-23 October 2012, Brussels, Belgium	EU meeting on "Social sciences contributing to natural hazards research: Towards better risk assessment and risk governance"	General outline of the MATRIX project and summary of the experience of the project towards a multi-risk approach	Disaster managers, researchers, policy makers	GFZ
29-31 October 2012, 2 nd MATRIX Annual General Assembly Naples, Italy	Various persons from other EU projects, and national platforms (Italy, Germany)	Annual MATRIX General Assembly, report on the project, with presentations from other projects and national representatives.	Representations of national platforms, other relevant projects.	GFZ, AMRA, BRGM, and the MATRIX consortium
19-26 November 2012, Portugal	Interaction with WP4. Presentation of the MATRIX project to the local community of Monchique (South of Portugal)	Presentation of the MATRIX project and discussion with the local authorities, Civil Protection and with the community about the vulnerability to wildfires by Conceição Colaço.	Local authorities, Civil Protection and population	ISA-CEABN
22 November 2012 Brussels, Belgium	ECHO Expert meeting on disaster risk assessment and other prevention priorities	General outline of the MATRIX project.	Disaster managers, researchers, policy makers	GFZ

Date	Type of interaction	Short Description	Target group	Organiser(s)
22 November 2012, Brussels, Belgium	ECHO Expert meeting on disaster risk assessment and other prevention priorities	General outline of the MATRIX project and summary of the most recent results	Disaster managers, researchers, policy makers	GFZ
4-5 December 2012, Riga, Latvia	Workshop	Presentation (by GFZ) about the MATRIX project given to participants in the multi-risk project (no. 14.3) within the EU strategy for the Baltic Region (EUSBSR)	Disaster managers, hazard and risk practitioners (academic, governmental, response)	EUSBSR Flagship project 14.3
2-6 December 2012, Algeria	Workshop on Forest Fires in the Mediterranean Region	Presentation of the MATRIX project and the theme "Forest management for efficient wildfire prevention. Use of prescribed fire for wildfire prevention at national level" by Francisco Rego.	Civil Protection, Scientific Community and Politicians	ISA-CEABN
22-25 January 2013	Caribbean Waves, Guadeloupe	Multirisk assessment in Guadeloupe. Risk comparison between earthquake and storm surges based on potential direct economic losses D. Monfort, S. Lecacheux, H. Muller, A. Reveillère, D. Bertil & O. Sedan;	-	BRGM
7 - 12 April 2013, Vienna, Austria	EGU General Assembly 2013, Oral presentation: "Fragility analysis of flood protection structures in earthquake and flood prone areas around Cologne, Germany for multi-hazard risk assessment"	A methodology for fragility analyses of fluvial earthen dikes in earthquake and flood prone areas around Cologne is being developed in the frame of the MATRIX WP3. The seismic fragility of the dikes is considered in terms of liquefaction potential. The obtained vulnerability estimates are used to calculate the flood risk when considering the temporal coincidence of seismic and flood events.	Hazard and risk researchers	GFZ
7 – 12 April 2013, Vienna,	EGU General Assembly 2013, Conference session	Session dealing with cascade effects, including the interactions between natural	Hazard and risk researchers	GFZ, AMRA, Lomonosov Moscow

Date	Type of interaction	Short Description	Target group	Organiser(s)
Austria	“Multi-hazard natural and technological risks: assessments and impacts”	and NaTech events, uncertainty propagation and, temporal dependency (short-term sequences where hazards occur almost simultaneously or are triggered, to longer-term scenarios covering several months or years.		State University, JRC-EC, IMDEA
07-12 April 2013	EGU 2013	Combined adverse effects of cascading events on systems’ functionality: an insular case study, French West Indies N. Desramaut, J. Wang, P. Gehl, J. Marti, A. Baills, A. Reveillere;	Geoscientists	BRGM
07-12 April 2013	EGU 2013	Observed and estimated economic losses in Guadeloupe (French Antilles) after Les Saintes Earthquake (2004). Application to risk comparison Daniel Monfort, Arnaud Reveillère, Sophie Lecacheux, Héloïse Muller, Ludovic Grisanti, Audrey Baills, Didier Bertil, Olivier Sedan, and Pierre Tinard	Geoscientists	BRGM
07-12 April 2013	EGU 2013	Managing disaster risks. Press conference. Reinhard Mechler, Stefan Hochreiner-Stiegler, Nadejda Komendantova	Geoscientists	IIASA
07-12 April 2013	EGU 2013	Efficiency of risk management and decision-support tools, Reinard Mechler	Geoscientists	IIASA
07-12 April 2013	EGU 2013	Modelling multi-risk and risk management, Stefan Hochreiner-Stiegler	Geoscientists	IIASA
07-12 April 2013	EGU 2013	Influence of behavioural and cognitive biases on implementation of multi-risk mitigation measures, Nadejda	Geoscientists	IIASA

Date	Type of interaction	Short Description	Target group	Organiser(s)
		Komendantova		
April 2013	GRIPWEB	General MATRIX Information uploaded to GRIPWEB. GRIPWEB is “an innovative information and knowledge tool for disaster risk assessment professionals, practitioners, and policy and decision makers.” and “an online platform for those who want to share practices and experience, develop methodologies, tools and guidelines or build their skills in risk assessment in the information era, based on the concept of centralized integration and personalized consumption of risk information and knowledge”.	disaster risk assessment professionals, practitioners, and policy and decision makers	DKKV / GFZ
May 2013 / Naples	Workshop	The goal of the workshop was to discuss findings from D 6.2 and D 6.3 on individual and institutional barriers to decision-making.	The participants will include local stakeholders from Guadeloupe. Two workshops with the same structure in order to combine findings from both workshops and further on identify barriers and benefits for multi-hazard mitigation and adaptation. (see Workshop Naples)	AMRA / IIASA
March 2013	Workshop Concept Note	2nd MATRIX Stakeholder Workshop. Concept Note	National Platforms / Civil Protection Authorities / private sector	DKKV / KIT / GFZ
4. June 2013 / Guadeloupe	Workshop	The goal of the workshop was to present the work done on the Guadeloupian test case within the framework of MATRIX. The presentations concentrated on the D4.3, D 6.2, D6.3 and D7.4 results: <ul style="list-style-type: none"> • Presentation of the MATRIX Project: administrative issues and multi-risks 	The participants included local stakeholders from Guadeloupe. Two workshops with the same structure in order to combine findings from both workshops and further on identify barriers and benefits for multi-hazard mitigation and adaptation.	BRGM / IIASA

Date	Type of interaction	Short Description	Target group	Organiser(s)
		<p>approach (BRGM)</p> <ul style="list-style-type: none"> • Presentation of seismic and cyclonic risks comparison in Guadeloupe (BRGM) • Presentation of combined effects of cascading events on networks functionality (BRGM) • Multi-risks approach and natural risks management in Guadeloupe (BRGM) • Institutional barriers for multi-hazard and risk governance in Naples and Guadeloupe (IIASA) • Cognitive and behavioural biases and their perceptions by stakeholders from practice (IIASA) • Round table : Feedback of MATRIX for taking into account of combined or cascading risks; which lesson to draw from comparison between Guadeloupe and Naples? 		
27/28 June 2013, Königswinter	2 nd MATRIX Stakeholder Workshop	<p>Past and Future Challenges in Multi-Risk Practice. The aim of the workshop is to identify lessons learned and gaps from past multi-hazard events. Expected outcomes include: Clarification of multi-risk concepts (cascading and conjoint events), requirements and challenges from the scientific assessment, response, mitigation and private sector perspective; Recommendations for future research from a Civil Protection and private sector</p>	European National Platforms for DRR and Civil Protection Authorities, Private Sector including Insurance and Operators of Critical Infrastructures	DKKV / KIT / GFZ

Date	Type of interaction	Short Description	Target group	Organiser(s)
		perspective; Identification of knowledge gaps in assessment and consequence analysis regarding catastrophic impacts on critical infrastructure; Documentation of the findings and further discussion within the European National Platforms for Disaster Risk Reduction.		
5. July 2013	CEDIM FDA/BBK Meeting, BBK Headquarters, Bonn	Presentation of the Risk Matrix Decision Support Tool at the Federal Office of Civil Protection and Disaster Assistance (BBK) in Germany. Received feedback on applicability and requirements for the Decision Support Tool. This interaction is a follow-up activity of the 1 st MATRIX Stakeholder Workshop.	German Civil Protection Authority	KIT / BBK
15. July 2013	Workshop feedback sheet	Feedback sheet submitted after the 2 nd MATRIX Stakeholder Workshop	National Platforms for DRR and Civil Protection Authorities	DKKV / KIT / GFZ
29. August 2013	RGS-IBG Annual International Conference 2013. Session on risk and responsibility sharing	Are the European natural hazard governance systems ready for multi-risk mitigation and management? Nadejda Komendantova, Anna Scolobig, Charlotte Vinchon. With contribution of : Anthony Patt , Daniel Monfort-Climent, Mendy Bengoubou-Valerius, Paolo Gasparini, Angela Di Ruocco, Alexander Garcia-Aristizabal	Royal Geographic Society	IIASA / BRGM / AMRA
23-25 September 2013	Presentation of MATRIX at the 4 th European Forum of National Platforms	Presentation of MATRIX and the results to representatives of European National Platforms	National Platforms / Civil Protection Authorities	DKKV
30 th September-2 nd October 2013	International conference on forest fire risk	Assessment of house vulnerability to wildfires in Portugal. – Oral communication	Researchers, foresters, civil defence officers.	ISA-CEABN

Date	Type of interaction	Short Description	Target group	Organiser(s)
	modelling and mapping “Vulnerability to forest fire at wildland-urban interfaces”	by Conceição Colaço, Francisco Rego		
30 th September- 2 nd October 2013	International Conference „Geophysical observatories, multifunctional GIS and data mining“.	Generic Multi-Risk Model and Decision- Support Tool for Mitigation of Multiple Natural Hazards.	experts in geophysics, geoinformatics, environmental sciences	IIASA, IUGG, Russian Academy of Sciences
30 th September- 2 nd October 2013	International Conference „Geophysical observatories, multifunctional GIS and data mining“.	Process of communication from science to practice about multi-risk approach. Panellist, Session 3: Multifunctional intellectual methods for geophysical, ecological, socio-econometric and biomedical research.	experts in geophysics, geoinformatics, environmental sciences	IIASA, IUGG, Russian Academy of Sciences

Appendix 4 – Minutes of the 2nd MATRIX Stakeholder Workshop

Minutes of the 2nd MATRIX Stakeholder Workshop Past and Future Challenges in Multi-Risk Practice

Königswinter 27. / 28. June 2013



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General Introduction and Workshop Objectives

The 2nd MATRIX Stakeholder Workshop took place in Königswinter at the premises of the AZK (Arbeitnehmer-Zentrum Königswinter) on 27./28. June 2013. The workshop focused on the case studies being considered in the MATRIX project and case study presentations prepared by the MATRIX cooperation partners.

R. Mrzyglocki gave an introduction to the objectives of the workshop. The main objectives and questions were specified as:

- What are past and future challenges and perspectives in multi-risk?
- What is required in order to be able to better cope with multi-risk hazards in the future and what are the demands on cascading event analysis?
- Are there any knowledge and data gaps that need to be resolved in order to facilitate risk assessment processes at the stakeholder levels?
- How to better integrate stakeholder demands into research agendas?
- What are the institutional barriers to multi-hazard and risk governance?

After the 1st MATRIX Stakeholder Workshop, it was agreed to publish a scientific paper on the results of the workshop. R. Mrzyglocki took the opportunity to thank the cooperation partners of the first MATRIX workshop for providing feedback on the scientific paper. He informed the attendants that the MATRIX project team is currently integrating the feedbacks into the final version of the paper⁸ and that it will be submitted to *Natural Hazards* or the *International Journal of Disaster Risk Reduction* soon.

He thanked also the Federal Office for Civil Protection and Disaster Assistance (BBK, Germany), the Italian Civil Protection Department, the Center for Climate and Safety of the Karlstad University (Sweden) and those who were not able to attend the current meeting for the support received in terms of disseminating MATRIX information on websites and in civil protection magazines.

He also encouraged the participants to disseminate information about MATRIX and informed about the availability of dissemination material (e.g. on-going publications).

The presentations of the workshops are available on the internet⁹.

⁸ Note the paper "Evaluating stakeholder perceptions in multi-hazard and multi-risk decision support models" was submitted to the *International Journal of Disaster Risk Reduction* on the 9th July, 2013.

⁹ <http://www.dkkv.org/DE/events/default.asp?h=51>

Introduction to MATRIX and to the MATRIX test sites

Kevin Fleming (Helmholtz Centre Potsdam, GFZ)

K. Fleming from the GFZ gave a general introduction to the multi-risk concept and the MATRIX test sites and highlighted the importance of the multi-type hazard and risk assessment. The multi-type concept explicitly considers spatial and temporal relationships on the hazard and vulnerability levels. On the hazard level multi-type interactions include: triggering events, simultaneous or near simultaneous unrelated events and events increasing the likelihood of another event (e.g., drought and wildfires). Other interactions are on the vulnerability levels (e.g., increase of vulnerability of buildings due to a sequence of earthquakes), socio-economic level (e.g., coping capability of society) and the exposure level (e.g., depopulation of rural areas).

K. Fleming pointed to the fact that multi-risk is often ignored by different communities including scientist and civil protection. Ignoring spatial, temporal and causal relationships may lead to risk underestimations while such interactions may amplify the overall risk (see Blayais case study).

K. Fleming introduced the MATRIX case sites and displayed the possible cascading events. He also gave an update on the development of the MATRIX-Common IT sYstem (MATRIX-CITY) - an IT-tool where multi-hazards and multi-risks are implemented in a dynamic risk framework. Since the last MATRIX-Workshop, the system has been improved. For example, additional interactions like Na-Tech have been integrated and the general mathematical framework was improved. In terms of the communication of the MATRIX-CITY results, the MATRIX project team followed the advice of the stakeholders after the 1st MATRIX workshop. Instead of risk curves, now a risk matrix is used to display how risk changes when interactions of hazards are considered (see Figure 1).

In addition to the MATRIX-CITY prototype, one of the outcomes of MATRIX will be a conceptual framework that allows end users and stakeholders to identify if a detailed multi-risk assessment within a certain setting is required, or if single-risk assessment for the relevant hazards, without the consideration of interactions, is adequate. Furthermore, MATRIX already has contributed to an increased awareness of the need of the multi-type approach.

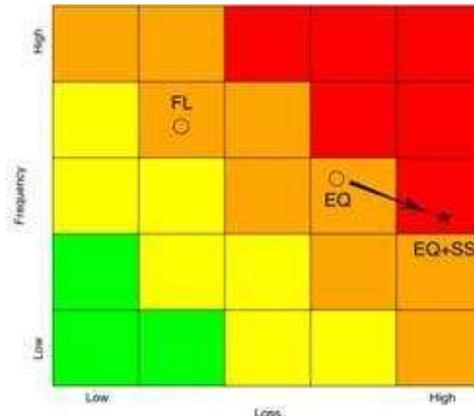


Figure 1: Risk matrix: shifting of risk when hazard interactions are enabled in MATRIX-CITY

K. Fleming presented a set of relevant questions. One question was related to the best possible metric for comparing losses of each risk type. It was stated during the following discussion that “a” best metric does not exist. It depends on the context of the investigations and expected outcomes for decisions making processes, which metric is more appropriate. Depending on the context, not only economic losses and fatalities, but also impacts on ecosystem could be crucial. Therefore, a better phrasing would be the “most appropriate metrics”.

An issue was raised with regards to databases or plans which are not capable of dealing with multi-risks. From a historical point of view, for example, databases for earthquakes and landslides or floods and landslides are maintained separately, although the hazards are closely interlinked.

The participants agreed that scenarios are more helpful than probabilistic approaches for decision makers. Scenarios are useful to overcome barriers with regards to different understandings of a current problem and allow the inclusion of different stakeholder perspectives. BBK, for example, considers in this context a reasonable worst case scenario. In contrast, probabilistic models include uncertainties which are difficult to communicate to local communities. An example was given for a community which was hit three times during a short time period by low probability floods. On the other hand, civil protection authorities give advice based on scientific data, which is based upon probabilistic approaches. What is required in this context is quality information and scientific results that allow the communication of uncertainties. Hence, from the perspective of civil protection, it is important to overcome major sources of uncertainty: data collection, data accessibility and more information about man-made hazards coming from the private sector.

Not only data availability was discussed, but also the topics of understanding, communicating and interpreting data and scientific results. It was discussed how to communicate the results to authorities at the local levels. It was stated that complex models are required, but must be easy to use (e.g., designing appropriate software solutions).

The interpretation of data cannot be assigned to the local levels, since adequate capabilities, including knowledge and even awareness about risk assessment, are often limited. Furthermore, within the context of interpreting data, the dynamics of the system needs to be considered (e.g., interpretation of historical data). In terms of communicating to decision makers, it was stated that communicating probabilities and magnitudes remains a difficult task. Contrary to this, loss assessments are better understood and can be communicated more easily.

It was concluded that putting different communities together is an important task. The approach chosen by MATRIX within this context was appreciated.

MATRIX: addressing multi-risk and multi-hazard in case studies: Guadeloupe, French Antilles

Daniel Monfort (Bureau de Recherches Géologiques et Minières, BRGM)

D. Monfort presented the research results of the MATRIX Guadeloupe case study. He displayed the regulatory risk assessment framework in France, including the Risk Prevention Plans and the role of the prefect in representing the central governance in the department, being in charge of civil security and hence is well aware of the local hazardous context; the prefect coordinates information delivery to the public, and prescribes and validates risk prevention plans asked for by the municipalities and prepared by scientists (either public or private research companies). D. Monfort highlighted the roles of different actors, pointing out the fact that risk assessment and monitoring is within the scientific community while the ministries and prefects are in charge of disaster management related tasks (prevention, preparedness etc.).

Current practice within framework of risk assessment in Guadeloupe (and in most French departments) consists of the superposition of different single-risk layers, while relationships between different hazards are very seldom taken into account.

D. Monfort presented a deterministic method for assessing the losses from earthquakes and storm surges. The metrics used for the loss assessment included the losses to buildings and content replacement of the buildings. Due to reasons of

risk comparability, fatalities were not considered as an appropriate metric for loss assessment. The methodology used for earthquake loss assessment to buildings was adapted in a way that allowed its applicability to the cases of storm surges.

Available data from the reinsurance (CaisseCentrale de Réassurance - CCR) was used for the validation of the models. The overestimated assessment of the losses compared to the observed data provided by CCR for the Saintes earthquake was explained by:

- No reimbursement of light damages, which have been assessed by the model.
- Low insurance ratio – contrary to that the model considered losses that were not insured.
- Challenges in terms of loss assessments for industrial and commercial assets.

The second part of the presentation included results on loss assessments due to earthquake triggered landslides and their impacts on critical infrastructures (e.g., the main roads, hospitals, electricity supply).

Before the 2nd MATRIX Stakeholder Workshop, a workshop was held with national and local authorities in Guadeloupe. The risk managers and decision makers expressed three major demands on the multi-risk analysis. These are:

- A software tool which estimates losses in real time.
- Better inclusion of Na-Tech hazards, as secondary (induced) events.
- The necessity to provide information on an economic basis (both as direct costs, from physical damages and indirect costs, from losses of incomes) to help decision makers to make arbitrations.

A question was raised about HAZUS and its applicability to Europe. HAZUS is a U.S. “standardized methodology that contains models for estimating potential losses from earthquakes, floods, and hurricanes“. It is used by communities, states, and emergency managers within different contexts of disaster management, including rapid loss assessment, disaster response and mitigation. It was stated that HAZUS works with the large database (hazards and buildings) that is available in the USA, while the applicability may be constrained for Europe due different vulnerabilities and building codes. The ISO risk definition was mentioned: “risk is the effect of uncertainty on objectives” meaning that without any uncertainties there would be no risk. It was stressed that uncertainties need to be considered when dealing with risk assessment and loss estimations. For example, the greatest incertitude parameter for seismic hazard assessment involves the employed attenuation relations. In another example, J. Rohmer from BRGM has been working within MATRIX with regards to the incertitude in family data within seismic risk scenarios for the Guadeloupe case.

The Cologne MATRIX test case

Kevin Fleming (Helmholtz Centre Potsdam, GFZ)

K. Fleming presented the research results of the Cologne MATRIX test case. He introduced the predominant hazards for Cologne which are: extreme cold and heat waves, earthquakes, flooding and winter storms. He presented some previous major disastrous events. Furthermore, he informed the meeting about available risk hazard and assessment for Cologne and presented the main reasons for dyke breaches. He introduced the vulnerability assessment of buildings being undertaken by using observations made by an omni-directional camera survey. The obtained images from the camera survey are combined with Landsat imagery and information obtained by their engineer via a foot survey of various districts of Cologne. This aspect has led to the discussion about the challenge of collecting data about location, exposure and vulnerability.

There was a question about the applicability of time-dependent vulnerability. Is it something that can be already used by civil protection or to have some tools/methods that will become more important in future? It was stated that involving the temporal vulnerability concepts is helpful to categorize which areas need to be evacuated in case of multi-hazard events.

With regard to this, the different approaches require (or result in) different databases and make the harmonization of risk curves difficult. Besides, there is an important aspect of communicating and presenting uncertainties at local levels. That means to prepare methods and tools for local authorities that are easy and simple to use for the end-users. The point was raised, however, that once scientists and engineers “give” uncertainties to end users, they may well ask what they are to do with them.

In addition, the multi hazard approach needs to consider cascading effects for critical infrastructures, in particular when considering the density of European lifelines and other networks.

MATRIX: addressing multi-risk and multi-hazard in case studies: Naples case study

Angela Di Ruocco (Analysis and Monitoring of Environmental Risk, AMRA)

A. Di Ruocco from the Center for the Analysis and Monitoring of Environmental Risk (AMRA) presented the research results of the MATRIX Naples case study. She gave

an overview about the risk governance and institutional and regulatory frameworks in Italy. Moreover, she introduced two scenarios for the Naples case study: 1) volcanic earthquakes and seismic swarms triggered by volcanic activity and 2) the simultaneous occurrence of ash-fall and earthquake hazards.

Within the context of identifying barriers for multi-risk the major point raised was the need for improved interdisciplinary interaction, including experts and operators.

In addition to this, she highlighted that qualitative analyses that concentrates on the decisions is necessary.

In regard to the fact that operational resources are limited, she raised the question of how to use research in an optimal way and how to interact at the local level. A possible option could be workshops with local authorities. The outcomes of such workshops could be used for planning, scenario identification and to overcome communication/understanding issues with the local authorities.

Multiple risk governance: barriers and benefits

Anna Scolobig (IIASA, International Institute for Applied System Analysis)

A. Scolobig presented the results obtained during the MATRIX project with regard to institutional barriers in the implementation of multi-risk assessment for the case studies of Guadeloupe and Naples. The objective of the session was to receive feedback from the participants on the research results.

Barriers in the science and practice domain

So far, the MATRIX research results show that most barriers to effective implementation of a multi-risk approach are to be found in the practice rather than in the society or science domain. The participants have had different opinions with regard to that. Interestingly, some scientific representatives emphasised the need to continue enhancing scientific knowledge, while some practitioners confirmed that the practical domain bears most of the institutional barriers.

Interagency cooperation within each administrative level

Similarly to the findings of the MATRIX research (WP6), it was found that multiple risk governance is influenced by challenges of interagency communication and cooperation across different levels. However, the cooperation for agencies working at the same administrative level is also very often a challenge.

Public private partnership

As already revealed by the research results, there is a lack of public-private partnership. With regard to the private sector, not only the role of insurances but also of private consultants has been discussed in previous stakeholder meetings. Very often, different consultants representing different stakeholders with conflicting interests are involved with the public bodies or private citizens in risk assessment

activities. As a result different risk assessments can be produced resulting in conflicts at the local level for decisions about safety standards and urban development.

Insurance systems and risk awareness

The insurance companies are important actors within DRR. There is cooperation between insurance and planning authorities, but not in a systematic way. There is a need for cooperation between the insurance and (local) authorities. Incentives to finance the relocation of risk prone estates are not common.

Participants had different opinions about the role of insurance in increasing risk awareness (attitude) and preparedness (behaviour). In Italy, there is no insurance available for most of the natural hazards (beside fires – with just a low number of buildings affected by fire) and the system is mostly based on State compensation after an event. Some participants maintain that if an insurance system is in place, the awareness would be probably higher because citizens would have to pay for the insurance. To provide seismic insurance would mean high financial loads for the communities.

The French insurance system make compulsory housing insurance, whether rented or owned. 90% of the people are insured for housing in France. In contrast to this, in Guadeloupe, only 50% of the people are insured due to a lower Gross Domestic Product (GDP). However, in specific cases (e.g., Xynthia, recent flood-landslides events in the Pyrenees), the government covers this lack of insurance coverage. There exist a formal cooperation between the insurance system and the local authorities, through the CATNAT system¹⁰. More recently, there is a new process in France to push people to take protective and DRR measures (“new push in France”) in order to receive the reimbursement from the insurance company; the role of the insurance is to check, if DRR measures have been implemented.

As reported by a participant, the main public thinking is: “I don’t want to live with floods, I want to be protected!”

Data availability

A crucial issue that goes far beyond the implementation of multi-risk assessment methodologies is data availability. Due to the sensitivity of data and the danger of misuse, access to data is sometimes restricted, depending also on the country and on the scale/level (e.g., national vs. municipal). In Italy for example seismic data from the Istituto Nazionale di Geofisica e Vulcanologia (INGV) is published online. The

¹⁰The “CATNAT” insurance, covering natural risks damages is included in the housing insurance coverage ; 12% of each premium is collected in the « Barnier fund », to promote risk knowledge and prevention measures and also covers indemnities if the reality of a natural disaster is validated by the ministry for interior ; the coverage decreases if no preventing action is taken by local authorities

challenge is to make use of these data. Too many data are published, sometimes without control. The question therefore is: Which data are available? For whom?

In other countries, the main challenge is data exchange inside and across different communities. This is a necessary step for the implementation of a multi-risk approach. Scientists and practitioners clearly have different objectives and interests and there is a need to come to a compromise in this context. As reported by one participant: “There is a lot of work to do in the natural science community and then we should start to work in-between the different sciences thus including the social sciences. The work done for this project represents a big step, for example for the interaction between seismic and volcanic risk, but there is still a long way to go.”

In addition, there is a lack of freeing important data and a lack of enforcing public databases.

More results on Barriers to risk government and challenges are reported in the Deliverable 6.3 and 6.4, as well as in the paper Scolobig et al., submitted

A case study of SEERISK project – Siófok, Hungary / Executing Risk Assessment in Siófok

Anikó Horváth/ Miklós Székely (National Directorate General for Disaster Management Ministry of Interior Hungary, NDGDM)

A Horváth and M. Székely from NDGDM presented the risk assessment for the city of Siófok within the framework of the SEERISK project. The project deals with climate change and risk assessments for different hazards in nine countries and six pilot areas in the South East European region. The aim is to formulate a common risk assessment methodology and to enhance the preparedness through local planning while considering intensified natural hazards created by climate change. A Horváth and M. Székely stated that there is an evident change in the magnitude and frequency of meteorological hazards. As a consequence of climate change, the uncertainty level becomes higher.

The presented case study executes a risk assessment of the Siófok pilot area in Hungary and its risks for extreme winds. In March this year for example, a “storm of the century” passed the pilot area. This kind of single risk assessment is a first step for Hungary with regards to accessing the risk and provides added value for the region in terms of security. Most challenging in the case of Siófok is to predict wind direction and define the spatial distribution of probability for wind speed at the local levels. The current models are not capable of capturing this hazard, hence a risk map cannot be prepared. In spite of this, exposure maps can be still developed.

The discussions following the presentation were set around the scarcity and harmonisation of data, the scale and accuracy issues of accessing wind phenomena and challenges in developing realistic scenarios when data is not available.

The importance of risk evaluation was highlighted in order to discuss which risks are acceptable and which should be treated.

Lessons Learned from windstorms for the Blayais Nuclear Power Plant

François Gérard (Association Française pour la Prévention des Catastrophes Naturelles, AFPCN)

F. Gérard from AFPCN, the French National Platform for DRR, gave a presentation on the lessons learned from the past storm event Martin for the Blayais nuclear power plant (NPP). The NPP, which is located in the Gironde estuary, was flooded by a storm surge during the wind storm Martin in 1999. Major factors that led to the incident were the accompanying high waves on the estuary caused by the wind storm and the wind direction, which pushed the waves against the shore dyke of the NPP. While the storm surge itself was taken into account for the design criteria of the shore dyke, the cascading events had not been considered. This led to the underestimation of the risk of the phenomena and was closely linked to knowledge gaps in terms of multi-risk assessment. It shows that multi-type events can result in shifts of risk (e.g., $1+1 \gg 2$) and that small spatial scales need to be considered within a multi-risk environment (e.g., effects of wind on wave height). The case study showed that it is important to consider multi-type hazard and risk assessment in order to retrieve more realistic scenarios, be able to set appropriate design criteria, provide appropriate warnings and regulatory frameworks. The event caused, amongst others, a loss of electricity on 2 generators and the inundation of sensitive areas of the NPP.

Based on the experience of the Blayais incidents and the wind storms, various improvements have been implemented at different levels:

- The incident led to a call for a multi-risk approach.
- Upgraded protection, including a higher dyke at the NPP and the revision of the internal alert system.
- The Gironde forecast system, which includes a model that considers wave height, started operating in 2009 (Open-source model).
- A reassessment of all plants with regards to inundations.
- Improved communications and intervention plans

- Vigilance system for floods and wind.
- New directives and regulations for inundation for NPP.

During wind storm Xynthia, the Girdone estuary was flooded again, while the Blayais NPP was not affected due to the upgraded protection and alert systems.

The incident had minor effects to electricity gaps.

Multi-risk in the region of Lake Vänern and River Götaälv: Cascading events, floods and landslides

Lars Nyberg (Centre for Climate and Safety, Karlstad University)

L. Nyberg from the Center for Climate and Safety introduced their investigations with regards to cascading events, floods and landslides for the region of Lake Vänern and River Göta in Sweden. The region around the biggest lake in the EU is prone to floods and landslides. Floods are sometimes lasting for long periods in the region. In 2000/2001, the flood lasted for six month. The area is also prone to Na-Tech events since heavy industry and hydro-power plants are located there. Furthermore, the area is important for the regional drinking water supply (800.000 persons). The Götaälv river valley is one of the most prone areas to landslides in Sweden and includes Göteborg, with Sweden's most important port. The landslides of the Götaälv valley include quick clay phenomena caused by the washing-out of salt parts of the soil, leading to liquefaction. Interestingly, municipalities around the Lake Vänern are charged for flood risk mapping.

The multi-risk concept is highly relevant for the region due to:

Water hazards		Landslides
High water velocity	→	Erosion along shore lines in rivers (RV) – increasing landslide (LS) risk
Low water level in river during wet period	→	Increasing LS risk in RV

Limited discharge from lake – increasing flood risk	←	Overall LS risk in RV
Flood wave in RV (water+sediment)	←	Slide blocking the river

Figure 2: Relationships and cascading effects between water related hazards and landslides (RV=river valley, LS=landslides).

The limited discharge of the lake can affect hydro-power plants, while wind effects on the lake can cause flooding.

L. Nyberg highlighted that it is important to consider disaster risk reduction measures that are in place in the risk analysis process in a feedback loop system in order to update the current vulnerability and probabilities of hazards.

He displayed the major pillars of the integrated flood risk management which comprises the health and environment, resources and socio-economic aspects.

He called for the need to establish a more systematic approach for the multi-risk analysis and a stronger cooperation among different departments (e.g., fire department and planning). In this context, he also presented the outstanding importance of the river groups in Sweden in terms of flood protection. At the same time, he called for the need for stronger cooperation of the river groups with the landslide experts in order to facilitate multi-risk concepts. In conclusion, there is an integrated approach for the assessment and management of landslides and floods in Sweden, while there is space for improvements.

Concepts for addressing multi-risk from the perspective of an insurance company

Olaf Burghoff (Gesamtverband der Deutschen Versicherungswirtschaft e. V., GDV)

O. Burghoff from the German Insurance Association (GDV) shortly outlined the tasks and services provided to the members of GDV. He focused more on single risks, while he also provided examples of multi-type events: local tornados during wind

storm Kyrill in the year 2007 and the 2002 flood, which was followed by a major storm/hail event a couple of weeks later.

The question was raised about incentives to reduce insurance in risk prone areas. Will the insurance cover the cost of moving a house to safer ground in case an estate is flooded every fifth year? It was outlined that financing a relocation of a building is not possible. However, in case the owner stays in the flood prone location, he will be reimbursed in case of a flood. An example was given, pointing to the situation in Canada, where flood insurance policies are not offered at all. It was stated that the insurance companies work together with planning authorities at some levels, but not in a very systematic way.

In terms of climate change, it was concluded that at the moment the models are not capable of predicting changes for the next 2 years, while this is a requirement in order to make them more applicable to the insurance sector.

It has been explained that there is no need to reassess the flood hazard after the current 2013 floods in Germany, due to the low effects of single peak events on the general hazard assessment. The current discussion about a compulsory insurance has been mentioned, which was initiated after the recent floods in Germany. Actually, the discussion is running and a final decision is not yet made.

It was mentioned that loss functions are more considered by the reinsurers and less by the insurers.

Web-based decision support in incident situations

Nenad Mladineo (Faculty of Civil Engineering, Architecture and Geodesy, University of Split)

N. Mladineo presented a web based decision support system for vessels in incident situations developed within the context of a project initiated in 2006 by the Ministry of the Sea, Tourism, Transport and Development of the Republic of Croatia. In this context, the Faculty of Civil Engineering and Architecture of the University of Split worked on the development of a system which, amongst other parameters, involved natural, socio-economic and bio-ecological characteristics in order to analyse possible threats to the environment and to provide solutions for marine response and crisis management. The support system is used operationally by the civil protection for emergency response and includes the NOAA Gnome oil spill model.

The main objective of the decision support tool is to determine best possible places of refuge for vessels in distress based on a multi-criteria analysis. The analysis includes 13 criteria, ranging from technical aspects of the vessel to ecological and socio-economic issues to emergency response matters. The system, called WDS-ISAS (Web-based Decision Support for Incident Situations in the Adriatic Sea), is fed by data and GIS-layers provided by different agencies. The approach might be regarded as a good practice in terms of multi-agency cooperation. Sensitive data is protected (e.g., information about the location of police vessels), resolving major challenges of data misuse.

Since the system is capable of integrating different layers (sea forecast, ecology, position of vessels, infrastructure, traffic, protected underwater sites etc.) coming from different agencies, the task of updating the data and information lies in the responsibility of contributing agencies.

In terms of international cooperation, a project is underway with Italy and Slovenia.

In terms of validation, it was stated that the quality of the results depends strongly on the quality of input data.

N. Mladineo gave an interactive presentation of the system which is available at: http://161.53.165.103/WebGIS/Labs/WDS_ISAS/

The decision support systems requires Microsoft Silverlight 5 plug-in for the browser

Natural hazards in Iceland and risk assessments

Sigrún Karlsdóttir (Icelandic Met Office)

S. Karlsdóttir presented the work of the Icelandic Meteorological Office (IMO). Iceland is prone to different hazards, such as volcanic eruptions, hurricanes, avalanches, earthquakes, flooding, landslides, mud slides and recently also bush fires. The tasks of the IMO are wide-ranging and are not limited to hydrological and meteorological phenomena, but amongst others include monitoring, forecasting and warning activities with regard to seismic and volcanic hazards, landslides and avalanches and other phenomena. "The main purpose of IMO is to contribute towards increased security and efficiency in society." IMO works closely with different authorities, for example the civil protection and private sectors.

Iceland is also prone to different multi-risk events. Volcanic eruptions can cause cascading effects for infrastructure, agriculture, fisheries, aviation and human health. Hence, multi-risk needs to be considered also on the vulnerability level. An example

was given for the near simultaneous sequence of some events, including severe weather, hard winters and the mudslides following a sharp increase in temperature from autumn 2012 to spring 2013, with effects on livestock, the environment and critical infrastructure.

S. Karldóttir showed the evolution of risk assessment in Iceland since 1975 up to the present day. The advances in risk assessment were pushed in 1995 after two devastating avalanches and led in 1995 to the establishment of a comprehensive risk assessment program. The approach is in good agreement with the Comprehensive Risk Assessment for Natural Hazards of the World Meteorological Organisation (WMO) and includes vulnerability and risk evaluation. This new approach was not only used to revise the current risk hazard zoning for avalanches, but also for other natural hazards. After 1995, the new approach contributed to a higher security in avalanche prone area where the affected population could be warned and evacuated in a timely fashion based on the improved risk assessment.

In the aftermath of the events in 1995, the subsequent implementation of the comprehensive risk assessment led to a controversial political discussion about potential negative consequences of risk assessment and defence structures for the development of municipalities. The major challenge in this context was recognized in educating and convincing people and local authorities about the societal benefits of risk assessment and required mitigation measures.

Conclusions

Based on the results from the work done on the MATRIX test sites and the other case studies presented, the workshop showed that it is important to consider multi-type hazard and risk assessment in order to retrieve more realistic scenarios, including information about multi-risk at the vulnerability level, be able to set appropriate design criteria for protecting infrastructures, provide appropriate warnings and to assist in developing regulatory frameworks. The workshop pointed to the fact that integrated risk assessment can be helpful for multi-risk assessment since knowledge, data and information from different disciplines, communities, and agencies can be combined and shared. Moreover, interagency cooperation can lead to the development of user friendly decision support systems based on data maintained by different authorities. There is a need for a more systematic cooperation and coordination between public authorities and the public and private sector (e.g., insurance and consultants). The challenge remains in educating and communicating the results and benefits of risk assessment to the general population and local authorities. This includes the challenge to develop methods of communicating uncertainties to local stakeholders. Probabilistic models include

uncertainties, which are difficult to communicate to local communities, while the results of loss assessments and scenarios can be communicated much more easily. However, quality information and scientific results that allow the communication of uncertainties are also required.

During the workshop, the participants identified research demands for hazard, risk and multi-risk assessments, knowledge and communication gaps and barriers and benefits for multiple risk governance.

Research demands

- Harmonisation of different risk curves, databases for all hazards and common damage assessments in order to achieve hazard and risk comparability.
- Probabilities for joint and cascading events.
- Recommendations are required on how local disaster management should deal with uncertainties in the decision making processes. Methodologies should be developed for improved communication of uncertainties. The challenge is to provide reliable information that is capable to convince local stakeholders.
- Loss assessments are of interest for the civil protection authorities, especially when they can be received in real time or timely. There is not “the best” or standard metric for loss assessment. The appropriate metric depends on the decision making context.
- Scenario development is of interest since different perspectives of different stakeholders can be considered and evaluated.
- Indirect and cascading effects should be considered in the research. There is a need to include Na-Tech within the context of hazard and risk assessment.
- Multi-risk needs to be considered at the vulnerability level. (e.g., improving the resilience of a building for one hazard can make it more vulnerable to other hazards)

Data availability and understanding

- Precise data and models are required in order to be able to cope with multi-risk, since slight changes in a multi-risk environment can shift risk from low to high. This was the case for the Blayais NPP, where the wind direction and wind effects on wave height had not been considered in the planning of the protection structures, leading to the flooding of the plant in the Gironde estuary. Knowledge gaps and lack of appropriate model resulted in an underestimation of the phenomena and the subsequent incident. Similarly, the scale issues of local wind conditions have been presented for the city of Siofók, where the development of a risk map is not possible due to the

challenges involved in the definition of the spatial distribution probability of wind speed. This leads to the question: What if we know about the required data only after the event? Can we act proactively before a hazard strikes and get to know which data is of upper most importance to avoid catastrophic outcomes of an event? Would scenario development be helpful in such contexts and point to potential cascading events?

- Even if data have been collected and is theoretically available, accessibility to data is sometimes constrained due to its sensitivity and danger of misuse. The question to whom data is available may be raised. Multi-agency approaches, including data protection policies like those presented in the case of the Web-based Decision Support for Incident Situations in the Adriatic, may be regarded as a good practice to overcome such challenges in future. The exchange of data and the feeding or merging of data, for example, in a user friendly software environment, has been presented and appreciated by the participants. Data sharing between agencies is possible. But, sensitive data needs to be protected and an added value needs to be identified for all involved stakeholders. Challenges in data accessibility are not limited to the private domain. The scientific community collects data with limited accessibility as well. Issues have also been identified with regards to uncontrolled publication of data, the freeing of important data and enforcing public databases.
- Climate change is hard to grasp due to the lack of long time series. The usability of climate change models for more practical applications (e.g., the insurance sector) is limited due to the low accuracy when it comes to short term prognoses (e.g., over 2 year periods).
- To assure that data is interpreted and understood correctly by officers at local levels, an appropriate way of communicating the results is important. Furthermore understanding of practitioners' needs is important in order to provide user-targeted (and not only user-friendly) research results. It has been, for example, shown that following the comments from the last Bonn stakeholder's meeting, improvements were made to the communications interface of MATRIX-CITY. The main change involved the use of a risk matrix instead of loss curves to describe how risk changes when multi-risk and interactions are considered.
- Data is sometimes owned by the private sector (energy suppliers, transportation etc.) but at the same time it is required for Na-Tech research activities.
- The dynamics of the environment and vulnerability need to be taken into account when interpreting data (e.g., historical flood data, demographic and climatic changes etc.).

Barriers in risk governance

- Some civil protection representatives confirmed that most institutional barriers are located in the practice domain, including institutional, financial and legislative barriers.
- Lack of follow-up in the implementation of EU-projects was recognized as a barrier. Another issue is the difficulty of obtaining deliverables and products produced during EU projects.
- Challenges in communication, interaction and coordination between different communities, agencies and disciplines have been identified as barriers at different levels. For example, between departments, authorities and scientific communities, and public bodies and private sector/consultants.
 - The cooperation between local authorities and the insurance sector is limited and needs to be strengthened in order to implement insurance concepts which allow for the reimbursement of the claimant considering protective and DRR measures at the household/local levels.
 - Public private partnerships require a clearer and more systematic approach, e.g., a more harmonized way to use consultants within the context of risk assessments.
 - Depending on the country and the scale considered, there are different issues with data, which are sometimes connected to the communication and cooperation issues: availability and exchange of data on the interagency level and availability of data owned by the scientific community.
 - Interactions between science and practice often start late, while a stronger involvement, cooperation and partnership in the development of the research projects can help to solve the practical challenges of providing research results already targeted for consultants or decision makers. Generally a late involvement of (local) stakeholders into research agendas was recognized as a barrier for stakeholder driven research, while the approach chosen by MATRIX to involve stakeholders from the very beginning in the selected case studies, the MATRIX IT framework and the general concept was appreciated by the participants, as well as the idea of involving stakeholders in drafting the initial concept of a project.
 - There is limited political awareness about multi-risk assessments. Sometimes, local politicians are worried about the consequences of risk assessments for the development of the municipality. There is a need to communicate the results and added value of risk assessment and

convince the society to take preventive measures, while also showing ways how to live with risks.

MATRIX-CITY framework

For the time being it was proposed to integrate the developed MATRIX-CITY methodologies into systems owned by the civil protection authorities, since the MATRIX-CITY framework is still at the development level. Even if the IT framework is not operational, its development was appreciated, since the current version of the IT tool is capable of raising awareness about multi-risk phenomena and to display differences when hazard interactions and cascading events are, or are not, considered.

Agenda

Day 1

Topic	Time	Speaker
Opening and Round of Introduction	13:00 - 13:15	All
General Introduction & Workshop Objectives	13:15 - 13:30	Mr. Friedemann Wenzel Karlsruhe Institute of Technology (KIT)
Introduction of MATRIX and the MATRIX Case Studies	13:30 - 13:45	Mr. Kevin Fleming Project Manager MATRIX German Research Centre for Geosciences (GFZ)
Discussion	13:45 - 14:15	All
Coffee Break	14:15 - 14:35	All
MATRIX: addressing multi-risk and multi-hazard in case studies	14:35 - 15:20	French West Indies Mr. Daniel Monfort Bureau de recherches géologiques et minières (BRGM)
	15:20 - 16:05	Cologne Mr. Kevin Fleming German Research Centre for Geosciences (GFZ)
	16:05 - 16:50	Naples Ms. Angela Di Ruocco Center for Analysis and Monitoring of Environmental Risk (AMRA)
Coffee Break	16:50 - 17:10	All
Institutional barriers to multi-hazard and risk governance	17:10 - 17:45	Ms. Anna Scolobig The International Institute for Applied Systems Analysis (IIASA)
SEERISK - risk assessment case study	17:45 - 18:20	Mrs Anikó Horvath / Mr Miklós Székely National Directorate General for Disaster Management (NDGDM)
Conclusions	18:20 - 18:40	
Dinner	20:00	

Day 2

Topic	Time	Speaker
Introduction and Objectives of Day 2	8:15 - 8:25	Mr.Friedemann Wenzel Karlsruhe Institute of Technology (KIT)
Historical multi-type events and multi-risk concepts	8:25 - 9:00	Mr. François Gérard Lessons Learned from windstorm Lothar and the Blayais Nuclear Power Plant incident during windstorm Xynthia Association Française pour la Prévention des Catastrophes Naturelles (AFPCN)
	9:00 - 9:35	Mr. Lars Nyberg Multi-risk in the region of Lake Vänern and River Götaälv: Cascading events, floods and landslides Centre for Climate and Safety (CCS) – Sweden
	09:35 - 9:55	Coffee Break
	09:55 - 10:30	Mr. Olaf Burghoff Concepts for addressing multi-risk from the perspective of an insurance company German Insurance Association (GDV)
	10:30 - 11:05	Ms.Sigrún Karlsdóttir Natural hazards in Iceland and risk assessments Icelandic Met Office (IMO)
	11:05 - 11:40	Mr.Nenad Mladineo Web-based decision support in incident situations Faculty of Civil Engineering, Architecture and Geodesy of the University of Split
Final Workshop Discussion	11:40 - 12:25	<ul style="list-style-type: none"> • perspectives in multi-risk assessment • demands on cascading event analysis • integrating stakeholder demands in research agendas
Conclusions and Closing	12:25 - 12:40	Mr.Friedemann Wenzel Karlsruhe Institute of Technology (KIT)
Lunch	12:40	

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