RAIN – Risk Analysis of Infrastructure Networks in Response to Extreme Weather

Project Reference: 608166

FP7-SEC-2013-1 Impact of extreme weather on critical infrastructure

Project Duration: 1 May 2014 – 30 April 2017

Security Sensitivity Committee Deliverable Evaluation

Deliverable Reference	**D 8.6**
Deliverable Name	**Reports from Workshops focusing on Infrastructure Managers**
Contributing Partners	**Youris.com**
Date of Submission	**April 2016**

The evaluation is:

- **The content is not related to general project management**
- **The content is related to general outcomes as dissemination and communication**

Diagram path 1-2. Therefor the evaluation is Public.

Decision of Evaluation	**Public**	~~**Confidential**~~
	~~**Restricted**~~	

Evaluator Name	**P.L. Prak, MSSM**
Evaluator Signature	**Not Signed**
Date of Evaluation	**2016-06-22**

This project has received funding from the European Union's Seventh Framework Programme for research, technological development and demonstration under grant agreement no 608166

This project is funded by the European Union

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D8.6 Reports from Workshops focusing on Infrastructure Managers

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Date: 01/04/2016

Dissemination level: PU

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DOCUMENT HISTORY

Index	Date	Author(s)	Main modifications
1	March 16th 2016	Alice De Ferrari	Structure of the document
2	April 4th 2016	Maria Nogal	Focus on Workshop n.1
3	April 20th 2016	Chiara Bianchizza	Focus on Workshop n.2
4	May 30th 2016	Alice De Ferrari	Final Revision

Document Name: D8.6 Reports from Workshops focusing on Infrastructure Managers

Work Package: WP8

Task: 8.7

Deliverable: 8.6

Deliverable scheduled date M24 April 2016

Responsible Partner: youris.com

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1. Executive Summary

In the framework of the RAIN Project, two workshops have been organised: the first one, hosted by Trinity College Dublin in November 2015, focusing on *Climate Change and Weather Modelling*, the second one, hosted by Delft University of Technology on April 2016, focusing on *Impact of Climate Change and Responses* to be given in terms of critical infrastructure security, involving infrastructure managers, utilities, planners and operators. Both workshops have been attended by more than 30 experts, with a good mix of RAIN partners and external stakeholders.

Both workshops have been promoted and disseminated before, during and after the event: all the possibly interested stakeholders were invited, all the presentations made during the workshop have been made available on the RAIN project website and the events were covered with live tweeting made by the official RAIN profile.

2. Introduction

This document provides a report on the activities made by the RAIN consortium about the two workshops organized during the project: for both events the agenda, the objectives and dissemination activities undertake are described. Furthermore, it outlines the main topics discussed, the exchange of ideas which occurred and the solutions proposed. The mission of this document is to orient research in the final part of the project.

3. Workshop No.1

3.1 Title

Rain Workshop: Climate Change and Weather Modelling.

3.2 Abstract

The workshop analysed the following topics:

- Presentation of the most likely extreme climatological events in Europe, namely heavy rainfall, windstorms, coastal floods, river floods, landslides, lightning, tornadoes, hail, convective windstorms, snowfall and snow storms, icing, snow loading, forest fires and freezing rain, based on extreme events during the past 25 years.
- Description of the natural causes leading to the extreme climatological events, oriented to non-experts on the physical background of the phenomenon.
- A detailed review of severe weather warning systems in Europe.
- Numerical weather prediction models to reliably forecast snowstorms, icing, and wildfire risk.
- Predictability of windstorms, heavy precipitation, floods and thunderstorm-related hazards.
- Modelling of severe thunderstorm risk in Europe.
- Assessing the impact of extreme weather events for single mode failures.

3.3 Objectives

The objectives of this workshop on climate change and weather modelling are threefold:

- Identification and analysis of the most probable extreme climatological phenomena affecting European infrastructure based on previous events.
- Detailed review of severe weather warning systems in Europe.
- Assessment of the frequency of weather hazards throughout Europe for both the present and future climate. This analysis, which is conducted by means of weather modelling, enables the estimation of the probability of occurrence of these events in the future.

3.4 Target

The workshop is beneficial for a broad range of critical infrastructure professionals, including engineers (geotechnics, hydraulics, pavements, traffic management), asset managers, climate change adaptation professionals, innovation managers and project managers.

3.5 Location and Date

The workshop took place in Trinity College Dublin (Ireland) on 9th November 2015, 10:00 - 17:00.

3.6 Agenda

Time table	Topic	Speaker
10.00 -10.15	Welcome and Introduction to the course	Alan O'Connor, coordinator of RAIN project (TCD)
10.15 -10.30	An overview of RAIN project	Alan O'Connor, coordinator of RAIN project (TCD)
10.30 -11.00	Weather extremes in Ireland: recent examples and influence of climate change	Ray Mc Grath (Met Eireann – The Irish Meteorological Service)
11.00 -11.30	Changes in severe winter events and forest fire danger in Europe with implication for critical infrastructure	Andrea Vajda (Finnish Meteorological Institute)
11.45 -12.15	Heavy precipitation in Europe	Katrin Nissen (Institut für Meteorologie, FUB)
12.15 -12.45	Extreme river discharges and storm surges in Europe	Dominik Paprotny (Delft University of Technology)
13.45 -14.15	A detailed review of severe weather warning systems in Europe	Alois M. Holzer (European Severe Storms Laboratory)
14.15 -14.45	Predictability of European windstorms	Nico Becker (Institut für Meteorologie, FUB)
14.45 -15.15	Modelling severe thunderstorm risk in Europe	Tomas Pucik (European Severe Storms Laboratory)
15.30 -16.00	Assessing the impact of extreme weather events for single mode failures	Donya Hajializadeh (Roughan & O'Donovan Innovative Solutions)
16.00 -17.00	Panel discussion and workshop closure	

3.7 Participants

The workshop involved the participation of 58 attendees, including a broad range of critical infrastructure professionals, including academics, infrastructural managers and consultants, from 28 universities, companies and organizations, such as

- University of Birmingham (UK), Queens University Belfast (UK), University of Surrey (UK), University of Cantabria (Spain), Austrian Institute of Technology (Austria), University College Dublin (Ireland), University College Cork (Ireland), HEAnet (Ireland), Trinity College Dublin (Ireland);
- Department of Agriculture (Ireland), Department of the Environment Community and Local Government (Ireland), Department of Transport Tourism and Sport (Ireland), Dublin City Council (Ireland), Kildare County Council (Ireland); Transport Infrastructure Ireland (Ireland), Office of Public Works (Ireland), Met Éireann (Irealnd);
- Irish Rail (Ireland), Irish Water (Ireland), ESB International (Ireland);
- IBM (Ireland), Arup (Ireland), AECOM (Ireland), Roughan and O'Donovan (Ireland), Ryan Hanley (Ireland), Future Analytics Consulting (Ireland), Gavin and Doherty Geosolutions (Ireland).

Figure 1 Participants during the RAIN Workshop in Trinity College Dublin.

3.8 Dissemination Activities

The promotional activities focused on the invitation to the workshop. The official invitation was sent to all the stakeholders (125 contacts) who have submitted to the RAIN website and to additional contacts suggested by partners. The information about the workshop was also disseminated on social media: on Twitter, through the RAIN profile, and in the RAIN LinkedIn group.

The workshop was promoted on Twitter with the publication of live tweets during the event. Remarkable quotes from speakers and updates were posted on the RAIN account, as well as retweets from participants.

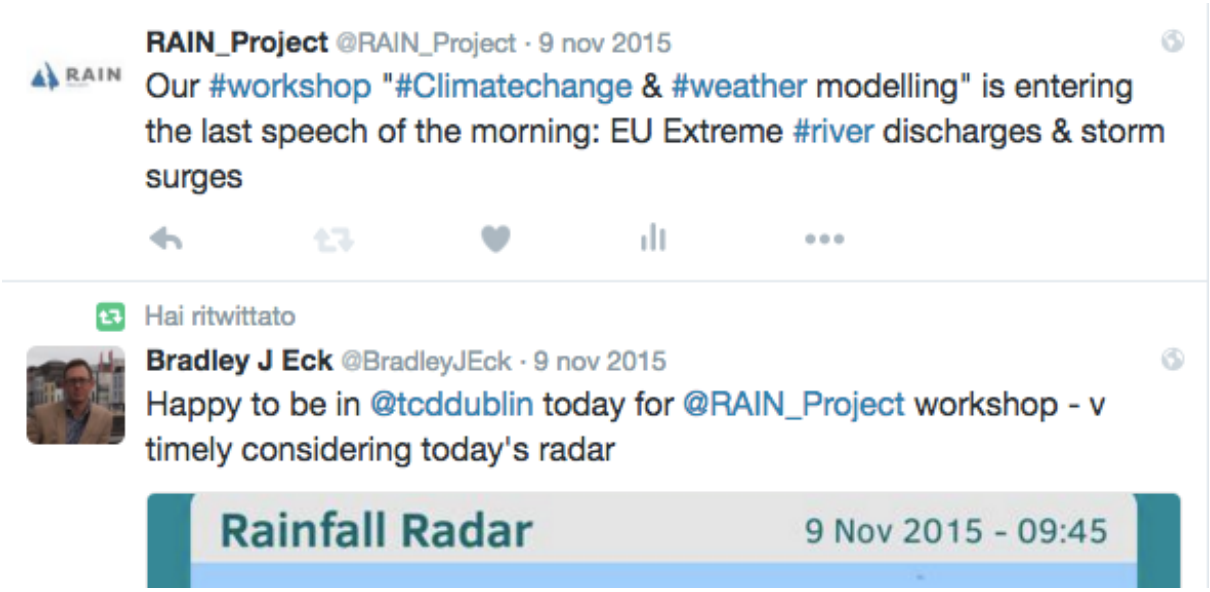

Figure 2 Example of tweets posted by RAIN and received during the workshop.

After the workshop, a press release was published on the RAIN website and all the presentation were released, available (here) for download.

Figure 3 Tweet to announce the possibility to download all the presentations on the RAIN Website.

3.9 Hot Topics

The event culminated in a panel discussion involving both the event presenters and interested stakeholders. This discussion assessed the impact of extreme weather and forecasting on disaster response planning, the selection of mitigation measures to combat impacts of a changing climate, and suggested the next steps in disseminating the findings of the RAIN project to the relevant decision makers across Europe.

3.10 Challenges Emerged

One of the principal challenges that emerged from the workshop is the need for weather forecasters and modellers to interact with infrastructure owners and utility providers, to ensure that these stakeholders have access to the appropriate weather information, and specifically, that this information is in a format that is interpretable by the decision maker.

3.11 Insight from Discussion

The discussion provided an insight into where stakeholders currently source their weather information, and how fit it is for purpose. It also highlighted issues such as the lack of knowledge within the critical infrastructure sector of sources of weather information that are already available. Transport operators highlighted that the type of information and the minimum advanced warnings they required were likely to depend on the nature of the predicted events. Electricity providers highlighted the role of cascading events, such as subsidence due to heavy rainfall, as a threat to their infrastructure. In general there appeared to be an appreciation from both weather modellers and infrastructure operators for each other's work, and an acknowledgement of need to work closely together in the future to help mitigate the impacts of extreme weather events.

3.12 Results

The principal result of the workshop was the emergence of a better understanding of the weather information and modelling techniques currently available, the state of the art and potential future

advances in this area, and the need for further interaction between infrastructure owners/operators and weather services.

3.13 Next Step/Proposed Solutions

The next steps for the RAIN project is to consider some of the issues discussed at the workshop, in particular with regard to how they can be incorporated into the outputs of WP7.

4. Workshop No.2

4.1 Title

RAIN Workshop: Critical Infrastructure Safety in Context of Climate Change

4.2 Objectives

The objectives of this workshop on critical infrastructure safety in the context of a changing climate are threefold:

- Identification of the most probable extreme climatological phenomena affecting Europe based on previous events.
- Analysis of risk to critical infrastructure for single events and cascading effects of single or multiple hazard events.
- Assess the societal, security and economic impacts of critical infrastructure failures.
- Identification of technical, logistical and response strategies that can mitigate risk to critical infrastructure.

4.3 Target

The workshop was beneficial for a broad range of critical infrastructure professionals, including engineers (geotechnics, hydraulics, pavements, traffic management), asset managers, climate change adaptation professionals, innovation managers and project managers.

4.4 Location and Date

The workshop took place in Delft University of Technology (The Netherlands) on 4th April 2016, 10:00 - 17:00.

4.5 Agenda

Time table	Topic	Speaker
10.00 -10.15	Welcome and Introduction to the course	Alan O'Connor, coordinator of RAIN project (TCD)
10.15 -10.30	An overview of RAIN project	Alan O'Connor, coordinator of RAIN project (TCD)
10.30 -10.55	Energy and Telecom infrastructure safety in context of climate change	Xavier Clotet Fons, Milenko Halat (AIA)
10.55 -11.20	A Framework for Critical Infrastructure Safety	Pieter van Gelder, Noel van Erp (TUD)
11.40 -12.05	Quantification of multi-mode risks and impacts	Mark Tucker, Ciaran Carey (ROD)
12.05 -12.30	ORT-application for the vulnerability index	Peter Prak (PSJ)
12.30 -12.55	Self-assessment tools for decision support systems	Chiara Bianchizza (ISIG)
13.55 -14.20	Heavy rainfall event in Zilina region, Slovakia, in	Maria Luskova (UNIZA)

	2014 and its impacts on infrastructure and society	
14.20 -14.45	Flooding at the Gulf of Finland – January 2005	Timo Hellenberg (HI)
14.45 -15.10	The effect of climate change on slope stability	Cormac Reale (GDG), Kenneth Gavin (GDG/TUD)
15.30 -16.00	STREST: stress tests for critical infrastructures against natural hazards	Wim Courage (TNO)
16.00 -17.00	Panel discussion and workshop closure	

4.6 Participants

The workshop drew 38 participants, including members of governmental institutions, consultancies, research institutes, from within and outside the Netherlands.

Figure 4 Participants during the RAIN Workshop in TU Delft.

4.7 Dissemination Activities

The promotional activities focused on the invitation to the workshop: the official invitation was sent to all the stakeholders (138 contacts) who have submitted to the RAIN website and to additional contacts suggested by partners. The information about the workshop was disseminated also on social media: on Twitter, through the RAIN profile, in the RAIN LinkedIn group and in other relevant groups.

Figure 5 Example of tweet promoting the workshop.

The workshop was covered by a live tweeting during the event.

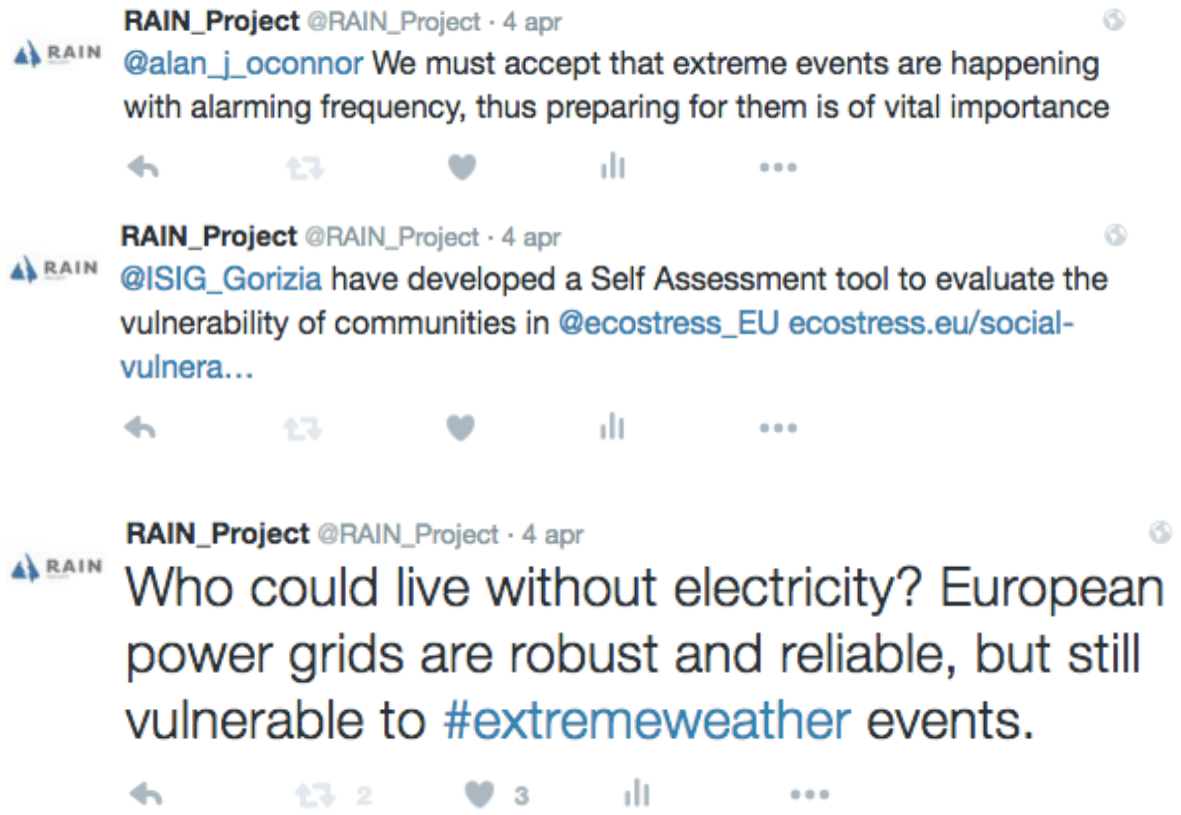

Figure 6 Example of tweets covering the discussion during the workshop.

After the workshop, a press release was published on the RAIN website and all the presentation were released, available (here) to be downloaded by everyone.

A section on the RAIN website dedicated to the workshops was created to facilitate navigation and make presentations more easily accessible (here).

4.8 Hot Topics

The workshop focused on impacts of climate change-related challenges on transport, energy and telecommunication infrastructures networks. The presentations dealt both with general aspects related to integrated management and coordination among stakeholders, and with specific aspects related to prediction of impacts of the events themselves and of their cascading effects.

The goal of the workshop was to identify main challenges in prediction systems and risk mitigation strategies, and to collect (also with the support of intervening stakeholders and twin-projects representatives from the STREST project) a set of potential solutions.

4.9 Challenges Emerged

Main challenges related to stakeholders' involvement/coordination:

- Public sector resistance/lack-of-trust to adapt new methods and learn from ”outside”
- Technology driven ”reforms” often hindering intra-organizational evolution
- Stakeholders/local managers are often left out of new projects/research and their needs are not sufficiently accounted for
- For building resilience of response to critical infrastructures failures there should be more communication capacity and an emphasis on public awareness.

Main challenges related to impact assessment

- The cascading failures, which can propagate through the multi modal networks, need to be modelled. The tools and methodologies applied to these challenges require data on hazards, infrastructure characteristics and the vulnerability of the relevant region. Acquisition of data from various sources can often be difficult and requires multi-disciplinary collaborations.
- Modelling of cascading effects implies a potentially huge amount of possible cascade/domino pathways that need to be evaluated.
- The effects of energy outages (either related to extreme weather events or not) are usually quantified in economical and engineering terms. Governmental regulations specify a number of “reliability indices”, that do not consider different potential effects on the population: e.g. losing 4 MWh of supply has different impacts on end users of a hospital, a factory, a residential area, or of a public transportation system like a railroad.

4.10 Insight from Discussion

The key words emerged for the round table relate to coordination and complementarity within a multi-disciplinary context. Different competences are needed to assess and predict impacts (from engineering to social sciences) as well as to engage stakeholders in a participatory debate. In fact new solutions for mitigation of impacts and reduction of resilience necessarily need to stem from the needs of operators and infrastructural managers.

Adapting the communication to different targets (i.e. making sure stakeholders and operators engaged in the project are adequately informed and can access to the solutions proposed by researchers/experts) was also outlined as a main issue to be addressed.

4.11 Next Step/Proposed Solutions

The final outcome of the discussion lead to considering a more careful and inclusive participation for stakeholders/end users within the RAIN project. Peter Prak, who organised a workshop with local (Dutch) stakeholders to start discussing criteria for a vulnerability/resilience assessment, took one first step in this direction within WP3 activities. An ORT tool will be elaborated as a result, to be used as a support for decision making.

For what concerns more specifically involvement of stakeholders within RAIN as a whole, coordinator and partners, together with members from other twin-projects, commit to continue to engage with each other to define the targets of the project products and communicate them effectively to each stakeholder’s category.

4.12 Conclusions

Overall, both events have marked a success within the RAIN project. The discussion was fruitful and has brought to light important points:

- The emergence of a better understanding of the weather information and modelling techniques currently available;
- The need for further interaction between infrastructure owners/operators and weather services.
- The importance of coordination and complementarity within a multi-disciplinary context.