



Novel indicators for identifying critical
INFRAstructure at RISK from Natural Hazards

Deliverable D1.2

Meetings with the Advisory Board



Primary Author	Mark Tucker/Roughan & O' Donovan Limited (ROD)
WP	1
Submission Date	28/06/2014
Primary Reviewer	Karlo Martinovic/Gavin and Doherty Geosolutions Ltd. (GDG)
Dissemination Level	PU

This project has received funding from the European Union's Seventh Programme for research, technological development and demonstration under grant agreement No 603960.

Project Information

<u>Project Duration:</u>	1/10/2013 - 30/09/2016
<u>Project Coordinator:</u>	Professor Eugene O' Brien Roughan & O' Donovan Limited eugene.obrien@rod.ie
<u>Work Programme:</u>	2013 Cooperation Theme 6: Environment (Including Climate Change).
<u>Call Topic:</u>	Env.2013.6.4-4 Towards Stress Testing of Critical Infrastructure Against Natural Hazards-FP7-ENV-2013-two stage.
<u>Project Website:</u>	www.infrarisk-fp7.eu

Partners:



Roughan & O' Donovan Limited, Ireland



Eidgenössische Technische Hochschule Zürich
Swiss Federal Institute of Technology Zurich

Eidgenössische Technische Hochschule Zürich, Switzerland.



Dragados SA, Spain.



Gavin and Doherty Geosolutions Ltd., Ireland.



Probabilistic Solutions Consult and Training BV, Netherlands.



Agencia Estatal Consejo Superior de Investigaciones Científicas,
Spain.



University College London, United Kingdom.



PSJ, Netherlands.



Stiftelsen SINTEF, Norway.



Ritchey Consulting AB, Sweden.



University of Southampton (IT Innovation Centre), United
Kingdom.

Document Information

Version	Date	Description	Primary Author
Rev01	30/03/2013	Draft for review	Mark Tucker
Rev02	23/06/2014	Final for review by GDG	Mark Tucker
Rev03	24/06/2014	Final	Mark Tucker
Rev04	28/06/2014	Re-upload to EC Participant Portal with amendment	Mark Tucker

This document and the information contained herein may not be copied, used or disclosed in whole or part except with the prior written permission of the partners of the INFRARISK Consortium. The copyright and foregoing restriction on copying, use and disclosure extend to all media in which this information may be embodied, including magnetic storage, computer print-out, visual display, etc.

The information included in this document is correct to the best of the authors' knowledge. However, the document is supplied without liability for errors and omissions.

All rights reserved.

Executive Summary

This report describes the first meeting of the INFRARISK Steering Committee with the External Expert Advisory Board that took place on the 19th March 2014 in Roughan & O' Donovan Limited offices in Dublin, Ireland. The participants included members of the INFRARISK consortium and members of the Advisory Board. The meeting provided the coordinator with the opportunity to meet members of the Advisory Board and discuss various aspects of the INFRARISK project. PowerPoint presentations were given by the coordinator on the technical aspects of the project and progress to date. Meeting minutes, which provided a formal record of discussions, were produced.

Table of Contents

1.0	INTRODUCTION	1
1.1	Project Concept	1
2.0	THE ADVISORY BOARD	2
2.1	The Role of the Advisory Board	2
2.2	Members of the Advisory Board	3
3.0	THE MEETING	4
3.1	Purpose of the Meeting	4
3.2	Attendance at Meeting	4
3.3	Meeting Overview	4
3.3.1	Introduction	4
3.3.2	Conceptual Modelling	5
3.3.3	Case Studies	8
3.3.4	Implementation and Dissemination and Software	9
4.0	CONCLUSION	10
APPENDIX A: MEETING AGENDA		
APPENDIX B: MEETING MINUTES		

1.0 INTRODUCTION

1.1 Project Concept

The INFRARISK project (*novel indicators for identifying critical **INFRA**structure at **RISK** from natural hazards*) is a European Union funded 7th Framework project under the 2013 'Environmental (Including Climate Change)' work programme. The project commenced on the 1st October 2013 and is due for completion on the 30th September 2016.

The research focus of INFRARISK is centred around developing reliable stress tests on European Critical Infrastructure (CI), using integrated modelling tools for decision-support to establish the resilience of European CI to rare low frequency extreme events and to aid decision making in the long term regarding robust infrastructure development and protection of existing infrastructure. To this end, an operational analysis framework will be developed through robust risk and uncertainty modelling that considers not only the impact of individual hazards on specific infrastructure systems but the coupled interdependencies of critical infrastructure, climate change, cascading hazards, cascading effects and time dependent vulnerability. Practical software tools and benchmark guidelines will be developed that support European infrastructure managers in assessing the probability of occurrence of extreme rare events and assessing the vulnerability of critical infrastructure, arming them with the necessary tools to develop robust mitigation and response strategies.

2.0 THE ADVISORY BOARD

2.1 The Role of the Advisory Board

In order to maximize the visibility and relevance of the research conducted in INFRARISK, an Advisory Board was selected which comprises of independent external experts in key areas and includes infrastructure managers and operators, infrastructure sector experts, crisis management experts and policy experts. The role of the advisory board is to give advice to the project consortium concerning the needs of industry, the feasibility of the proposed solutions, the long-term user requirements (policy and political impacts) and priorities (infrastructure sectors) and to allow user-group input into the consortium's work from the planning to the dissemination phases. Specifically it will provide a "quality check" and "practicality check" of the proposed activities. Furthermore, the advisory board will provide guidance on how the INFRARISK project will relate directly to industry and infrastructure managers. The advisory board will also provide input into the case study selection.

The advisory board will interact with the steering committee as shown in Figure 2.1, providing help to focus the project on the most pertinent challenges, ensure the outputs are tested, validated and provide benefit to the sector as a whole. It is expected that dissemination activities can be successfully implemented to a wide network of contacts and collaborations with national or international organisations and groups of interest through the various consortium members and through the INFRARISK advisory board.

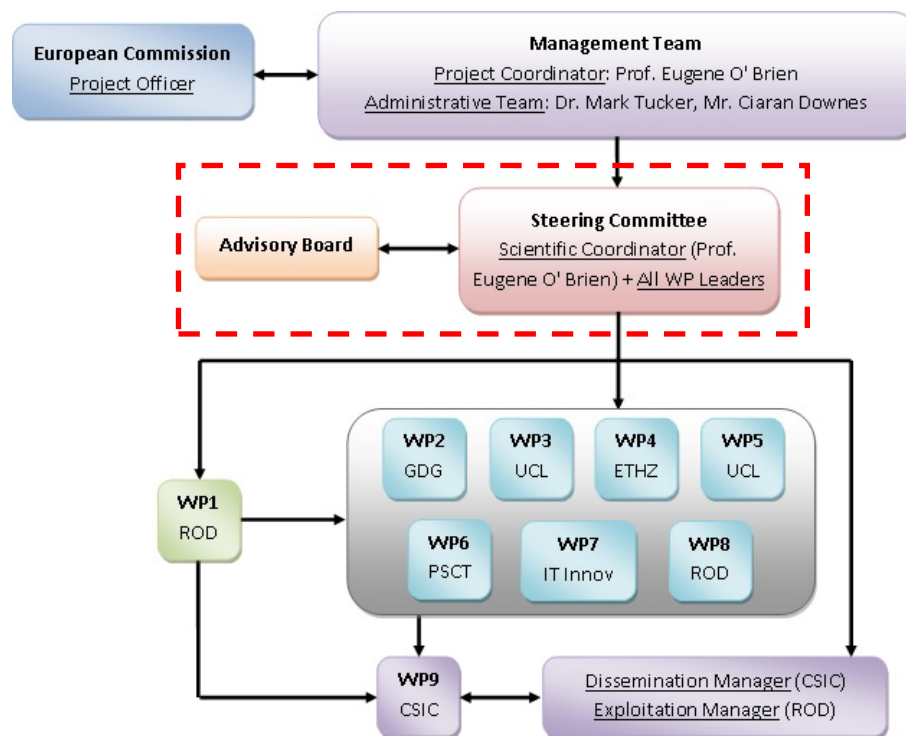


Figure 2.1: INFRARISK Management Structure

The advisory board's responsibilities include;

- Partake in the development of the conceptual model exercise at the outset of project (task 4.1);
- Advise on the priority problems of the industry and to provide strategic direction in the project (within the constraints of the contract);
- Provide advice and guidance on industrial and business aspects;
- Advise on the practicality, options for implementation and likely acceptance of the project outputs;
- Promote timely acceptance and implementation of the project outcomes;
- Ensure that the projects outputs are efficiently and appropriately disseminated;
- Liaise with key associations (such as ERRAC, European Rail Research Advisory Council, Trans European Network, TEN, National Critical Infrastructure Protection etc.);
- Provide advice on dissemination and exploitation activities;
- Act as Alpha testers for software developed.

2.2 Members of the Advisory Board

The Advisory Board members consist of the following personnel;

- Professor Peter Guthrie - Director of the Center for Sustainable Development at Cambridge University, United Kingdom. Chairperson of the Advisory Board.
- Albert Compte Anguela - Director at the Centre for Applied Techniques (CETA), Spain.
- Brian Bell – University of Surrey. Previously Senior Technology Engineer in Bridges at Network Rail, United Kingdom.
- Guy Weets – Managing Director of DRMC-Europe.
- Ramón Jané - Head of Unit of Technology Projects Technology & Engineering Division, Gas Natural Fenosa, Spain.
- Scira Menoni – Associate Professor at the Politecnico of Milan, Italy.
- Adewole Adesiyun - FEHRL, The Forum of European National Highway Research Laboratories, Brussels, Belgium.
- Christian Egenhofer, CEPS - The Center for European Policy Studies, Brussels, Belgium.
- Linda Hendy – NSAI, The National Standards Authority of Ireland.
- Ares Gabas Masip – Barcelona City Council, Spain.
- José Pires - Security Division, International Union of Railways (UIC), Paris, France.

3.0 THE MEETING

3.1 Purpose of the Meeting

The purpose of the meeting was to;

- Introduce the concept and goals of the INFRARISK project to the Advisory Board members;
- Advise the Advisory Board Members of their duties and responsibilities;
- Provide the Advisory Board members with an update on project progress;
- Seek input on the methodology and approach to the project to date;
- Seek advice, in particular on the General Morphological Analysis undertaken in the project as part of Work Package 4.

3.2 Attendance at Meeting

As a result of difficulties encountered in assembling all the Advisory Board members and steering committee members together at the same time, it was decided by the Coordinator that a date would be set for the meeting and those who could attend did so with the date selected based on the availability of the Chairman of the Advisory Board. Video conferencing (VC) facilities were also used to facilitate those who could not attend in person.

The minutes of the meeting, included in Appendix B, indicate the partners in attendance (via VC or in person) and the Advisory Board members in attendance.

3.3 Meeting Overview

3.3.1 Introduction

The points of discussion and recommendations/comments from the meeting are included in the meeting minutes of Appendix A. The following paragraphs describe in brief the main points of discussion.

The meeting commenced with presentations by the coordinator on the research objectives of INFRARISK, the progress being made in the first 6 months of the project and the role of the advisory board, Figure 3.1 and Figure 3.2.



Figure 3.1: Selected Screen Shots from Presentation



Figure 3.2: Selected Screen Shots from Presentation

3.3.2 Conceptual Modelling

The **Conceptual Modelling** process or ‘General Morphological Analysis (GMA)’ process was discussed in some detail. The preliminary outcomes of the first two GMA workshops conducted in Month 3 and Month 5 were discussed.

The GMA is a *Generalized Method for Structuring and Analysing Complex Problem Fields* which:

- Are Inherently non-quantifiable;
- Contain non-resolvable uncertainties;
- Cannot be casually modelled or Simulated;
- Require a Judgmental Approach.

The purpose of this methodology of decision support modelling is to;

- Defines the project’s total problem space - this helps to define the factors to be used for the dimensions for the project’s data base.
- Facilitates boundary research - this helps the project group bound its problem area from the outset.
- Creates a framework for a modelling laboratory - which can function as a “what if” inference model.
- Provides traceability and transparency - which creates an “audit trail” showing what assumptions and decisions were made in defining the problem space and synthesising the outcome space.
- Functions through group interaction and iteration - which provides a forum for collective creativity, engenders out-of-the-box thinking, and creates “smart teams”.
- Facilitates a graphical (visual) representation of the problem area for the systematic, group exploration of a solution space.

The process for a GMA can be summarised as follows;

- Formulate a focus question;
- Identify the relevant factors (parameters) involved (i.e. a Parameter Analysis);
- Analyse the mutual influence between these factors;
- Specify the possible states /values of each factor;

- Create a morphological (parameter) space;
- Find the combinations of factors that are inconsistent;
- Create Inference model;
- Generate and compare configurations,

In relation to the focus question, Figure 3.3, it was suggested that the question could be made more specific.

INFRARISK

Focus Question

- What are the most important/relevant parameters (i.e. factors or variables) **concerning infrastructure networks' resilience to rare and low probability extreme events**..... and how do these parameters relate to one another?

..... The response to this question will result in the formulation of the parameters considered

InfraRisk - Novel Indicators for Identifying Critical INFRAstructure at RISK from Natural Hazards

PRODS INNOVATIVE SOLUTIONS **Roughan & O'Donovan**

Figure 3.3: Focus Question

The advisory board also commented on possible amendments to the input parameters, Figure 3.4 and corresponding input model, Figure 3.5. The input model indicates factors to be considered in the input parameters. A particular item discussed in relation to the GMA was the difficulties in bounding the problem. It was suggested that we minimise the number of Input parameters in order to simplify the problem. The INFRARISK partners confirmed that this will be the next step in the GMA development.

INFRARISK



Parameters

- The Parameters arrived at initially were:
 - Types of hazards which can occur
 - Types of infrastructure affected/disrupted (Components of TEN-T infrastructure)
 - Related components of infrastructure disrupted (being considered)
 - Locations of infrastructure (in question)
 - Types of networks (being considered)
 - Extent of network
 - Material utilised in infrastructure
 - Physical condition of infrastructure (current state)
 - Code (Importance)
 - Level of service (Required Level of Service)
 - Criticality descriptor
 - Connectivity (in network)
 - Post event response & communication
 - Level of preventive actions

InfraRisk - Novel Indicators for Identifying Critical INFRAstructure at RISK from Natural Hazards

PRODS INNOVATIVE SOLUTIONS **Roughan & O'Donovan**

Figure 3.4: Input Parameters

Input Model

1. Types of hazards	2. Types of infrastructure	3. Related components of infrastructure	4. (Present ?) location of infrastructure	5. Types of networks (to which the infr.)	6. Extent of network involved	7. Material involved in the infrastructure	8. Current physical condition of infr.	9. Code (assessment code)	10. Level of service relative to RLS	11. Criticality descriptor for the infrastructure	12. Connectivity of the infrastructure (within network.)	13. Post event response & communication	14. Level of preventive actions
Earthquake	Roads sections	Signals/IT	Urban	Road	Local	Concrete RC or PSC	Perfect state	No code	Exceeds RLS	Major node	Intra-connected (within network.)	Specific/ dedicated planned response	Excellent inspection history
Landslides	Bridges/ viaducts	Power supply equipment	Rural	Rail	Regional	Steel	Light deterioration	Defunct code	Meets RLS	Used for rescue services	Inter-connected (between networks.)	General planned response	Regular/ standard inspection history
Avalanche	Tunnels	Open/closed channels / pipelines	Near fault	Waterways	National	Soil	Moderate deterioration	Low code	Less than RLS	Will create cascade	Not directly connected	Obsolete plan	No inspection history
Coastal flooding	Slopes	N/A	On coast		Trans-national	Rock	Significant struct. deterioration	Medium code	Not working	Evacuation route		No plan	
Fluvial flooding	Retaining structures		"Inland"		Pan-European	Masonry	Not fit for use	High code		Supply route			
Tsunamis	Flood defence		By river		Global	Timber							
Fluvial flooding	Rail line		Near volcano			Asphalt							
Storms etc.			In valley										
Extreme temps			Near dam										
Eruptions													

Infrarisk - Novel Indicators for Identifying Critical INFRAstructure at RISK from Natural Hazards








Figure 3.5: Input model

The output parameters, as illustrated in Figure 3.6, were also discussed.

Parameters

- The Output Parameters arrived at initially were:
 - Extent of consequences (area/scope)
 - Structural damage
 - Casualties / fatalities
 - Environmental impact
 - Rate of flow of traffic
 - Restoration/recovery time
 - Emergency services (involved/affected?)
 - Cost of damage
 - Cost of recovery

Infrarisk - Novel Indicators for Identifying Critical INFRAstructure at RISK from Natural Hazards






Figure 3.6: Output Parameters

3.3.3 Case Studies

The road and rail Case Studies selected by the consortium were also presented by ROD. The case studies consist of a portion of the existing A1 road network from Florence to Brennero in Italy and a planned rail network connecting Rijeka and Zagreb in Croatia. Particular aspects of the case studies discussed were the selection criteria, the definition of critical infrastructure, the hazards considered and the specific aspects of the data available for the two case studies. Selected screen shots from the presentation are shown in Figures 3.7 to Figure 3.12.

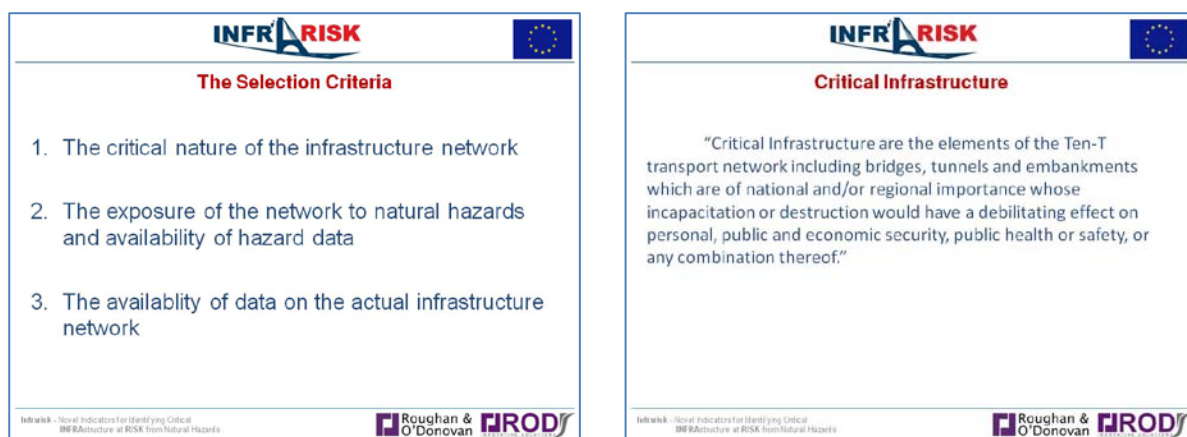


Figure 3.7: Case Study Presentation



Figure 3.8: Hazards Selected

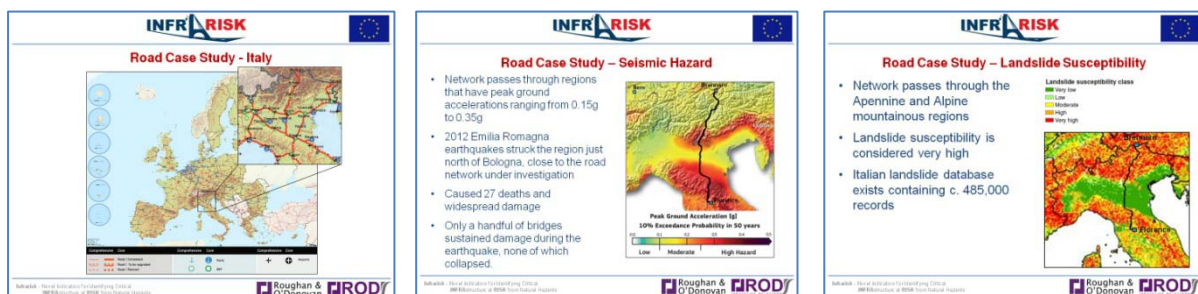


Figure 3.9: Road Case Study



Figure 3.10: Road Case Study

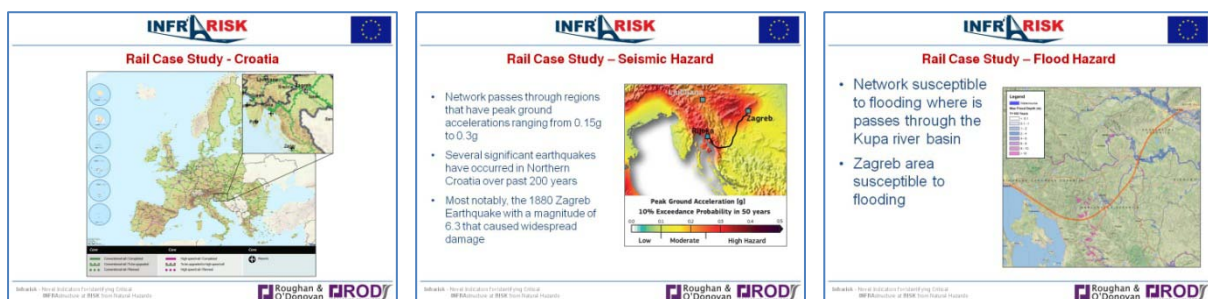


Figure 3.11: Rail Case Study

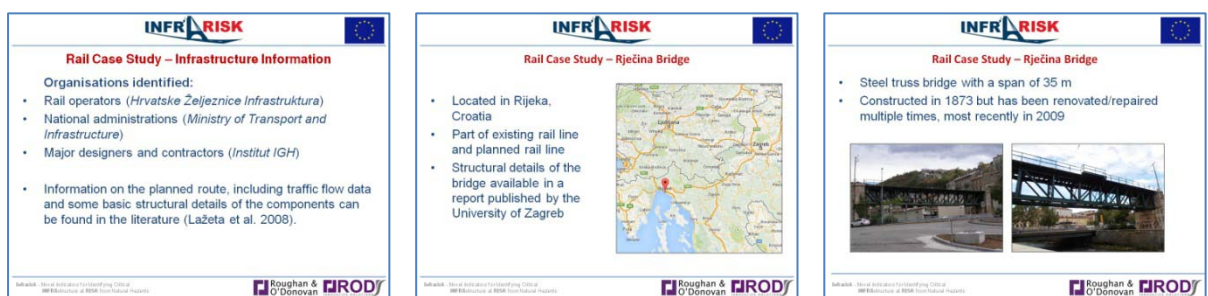


Figure 3.12: Rail Case Study

3.3.4 Implementation and Dissemination and Software

Discussions also took place on proposed implementation and dissemination activities and how important these aspects of the project were to ensure visibility and understanding of the project outputs. As an outcome of the discussions, the consortium has since submitted an abstract for a poster presentation at the IDRC Davos 2014 conference.

In relation to the software, it was noted that not only was the availability of the software important but also that providing training in the use of the software was also going to be critical and how potential end users are attracted to the training.

4.0 CONCLUSION

The INFRARISK Advisory Board meeting held in Dublin in early March 2013 proved to be a productive meeting and recommendations from the Advisory Boards members have been considered as the project has progressed in the intervening period. The next meeting is to be scheduled for late October 2014 to coincide with the 12 month progress meeting.

APPENDIX A: MEETING AGENDA

Agenda : Advisory Board Meeting No. 1

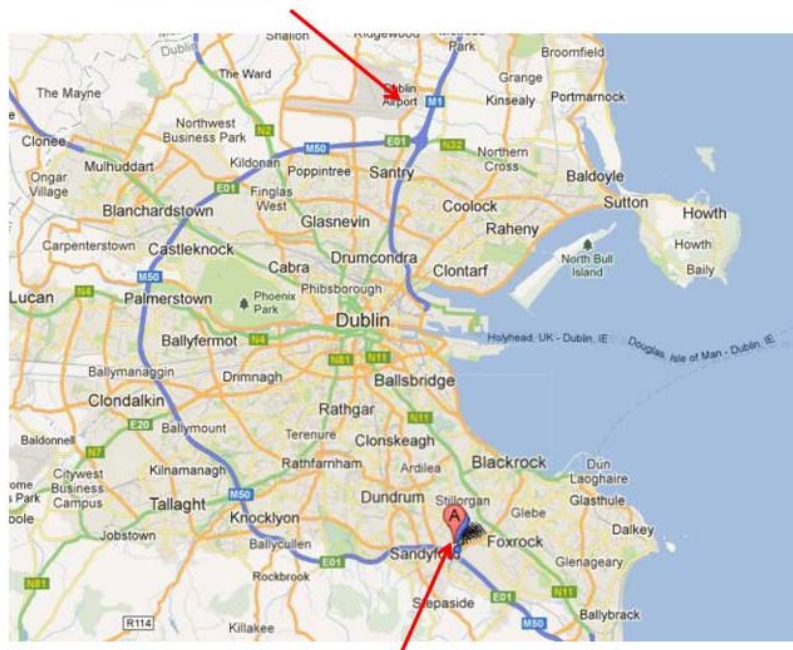
Project Title	novel indicators for identifying critical INFRA structure at RISK from natural hazards
Project Acronym:	INFRARISK
Purpose of Meeting	Advisory Board Meeting
Date of Meeting:	19 th March 2014
Location:	Roughan & O' Donovan (ROD), Arena House, Arena Road, Sandyford, Dublin 18, Ireland and Video Conferencing (see details at end of agenda)
Time:	10.00am to 4.00pm (UTC+0.00)

Time	Item	Chair
9.30am	Welcome and Coffee/Tea in ROD	All
10.00am	Welcome address by Project Coordinator	Prof. Eugene O' Brien (ROD)
10.05am	Round Table Introductions	All
10.15am	INFRARISK - Project Overview & Progress Update	Prof. Alan O' Connor (ROD)
10.30am	Role of Advisory Board <ul style="list-style-type: none"> • Conceptual Modelling ("GMA") • Case Studies • Implementation • Dissemination • Software 	Mark Tucker (ROD)
11.00am	Conceptual Modelling (GMA) introduction and Discussion	Prof. Alan O' Connor (ROD)
12.00 noon	Case studies introduction and Discussion	Mairead Ni Choine (ROD)
1.00pm	Lunch	
2.00pm	Implementation discussion	Mark Tucker (ROD)
2.30pm	Dissemination discussion	Mark Tucker (ROD)
3.00pm	Software discussion	Mark Tucker (ROD)
3.30pm	AOB	Mark Tucker (ROD)
4.00pm	Close	Mark Tucker (ROD)

Getting to and from Roughan & O' Donovan

Below is a marked up map of the greater Dublin area showing where our office is located relative to the airport - The airport is on the north side of the city and we are based on the south side of the city. A more detailed map of the office location can be viewed under the 'contact' section of our website (<http://www.rod.ie/>). The most direct route is via the M50 ring road.

Dublin Airport



Roughan & O' Donovan, Arena House Arena Road, Sandyford, Dublin 18

To the Office from the airport:

(Taxi or aircoach are best available options)

1. Hire a car and drive

Take the M50 ring road from the airport, exiting at Sandyford. There is a toll on this road which is only about €3 each way.

2. Taxi

Taxi ranks are located outside arrivals. Journey Cost can be between €40 - €60 depending on the route taken and time of the day. In terms of routes you could travel via the M50 ring road or via the city center. I would advise taking the M50 ring road which is quicker - the toll on this road will be included in the taxi fare.

3. Aircoach(<http://www.aircoach.ie/timetables/route-700-dublin-airport-leopardstownandsandyford>)

The buses are located outside arrival level to the left hand side. If heading directly to our office get on the bus to "Leopardstown". It takes about 80 minutes and the nearest stop to the office is *Bewleys* or *Burton Hall road*. Journey Cost is €15.00 Return . In the evening/morning rush hour, the journey could take 20 mins to 30 mins longer depending on traffic. This bus goes through the city center.

To the Office from the City Center:

If you are going into the city center from the airport first (e.g. night before) when you arrive, then you can use the same options as above to take you into the city center - Note: A Taxi to the city center is approximately €25 and aircoach is €12 return.

Then to get to the office:**1. Taxi**

Approximately €15 and takes about 30 mins (depending on the time of the day).

2. Aircoach

The buses pass through the city centre so there is a number of stops around the city. You could refer to the aircoach link above to see the city center stops on the leopardstown route.

3. Luas (Dublin Light Rail System - <http://www.luas.ie/interactive-map.html>)

This is an over ground metro service. You take the *green line* from the city centre, getting off at Sandyford. The journey takes about 30 mins. The office is a 5 min walk from the sandyford stop. Price is about €3.00 each way.

4. Dublin Bus Service

There is a bus service (<http://www.dublinbus.ie>). Take the no.11 from the city center (but this would be the least preferable option)

From the Office to the Airport/City Center:

The reverse journey of the options provided above - however we can advise on the day of the best method to return to the airport, depending on your travel arrangement etc. We can also arrange taxis to take you to the airport, into the city center etc.

Accommodation

If you plan to stay overnight we can get a reduced B&B rate at Bewleys Hotel in Leopardstown (<http://www.bewleyshotels.com/leopardstown>) - which is a few minutes' walk from the office (and one of the last stops on the aircoach). When you call reservations, inform them that you are attending a meeting at our offices and that you want to avail of the rate (If you have any problems in getting this rate this you can let us know). Alternatively if you are staying in the city center, you can use Dublin's Light Rail system (<http://www.luas.ie/>) to get to and from the city center with a journey time of approximately 30 minutes, disembarking at the Sandyford Station which is only a few minutes' walk from the office.

Accessing the Video Conference

We will be using a video conferencing facility (which in this particular case is preferable to skype) which will require users to install the software. To install the software mentioned above you will need to follow the instructions below on the following page. *On the day of the meeting, we will issue a link to your email address which will enable you to join the meeting.*

APPENDIX B: MEETING MINUTES

Meeting Minutes No. 1: Advisory Board

Project Title	Novel Indicators for identifying critical INFRA structure at RISK from Natural Hazards
Project Acronym:	INFRARISK
Call Topic:	Env.2013.6.4-4 Towards stress tests for critical infrastructure against natural hazards
Date of Meeting:	19th March 2014
Location:	Roughan & O' Donovan
Time:	10:00am - 4.00pm (+0.00 GMT)
Attendance:	ROD: Mark Tucker (MT); Mairead Ni Choine (MNC), Prof. Eugene O' Brien (EOB), Prof. Alan O' Connor (AOC) GDG: Karlo Martinović (KM) CSIC: Mariano Garcia-Fernandez (MGF) - <i>via Video Conferencing</i> Advisory Board (AB): <i>In Person:</i> Prof. Peter Guthrie (PG); Linda Hendy (LH); Brian Bell (BB); Ares Gabas Masip (AGM) <i>Via Video Conferencing:</i> Scira Menoni (SM)
Apologies:	Ramon Jane Crumols (RJC); Albert Compte Anguela (ACA); Guy Weets (GW); Adewole Adesiyun (AA); Christian Egenhofer (CE); Jose Pires (JP)
Prepared by:	Mark Tucker
Issued:	9 th April 2014

Item	Description	ACTION
1.	Welcome Address by Project Coordinator	
1.1	EOB introduced the project and played the INFRARISK video. MT to issue video to Advisory Board.	MT
2.	Introductions	
2.1	All present introduced themselves.	Note
3.	INFRARISK Project Overview and Progress	
3.1	AOC presented an overview of the project and the progress made in each Work Package. A discussion followed the presentation.	Note
3.2	MT to issue presentation to Advisory Board Members.	MT
3.3	EOB queried whether 'Deliverables' should be issued to AB members for a peer review prior to submission. BB suggested this should be a two stage review, once at an early stage and once before the finalised version is issued. The review would consist of an overview of the deliverable content and scope (not a technical review).	Note
3.4	LH requested a copy of deliverables and dates to be issued along with description of work packages.	Note
3.5	As per 3.3 and 3.4, MT to circulate Deliverables list and dates along with description of work packages (objectives and tasks).	MT
3.6	LH referred to standards in relation to Societal Security and in particular ISO 31010 on risk assessment and methodologies which could be relevant. This work is being undertaken by NSAI and a consultant Sean Coleman.	Note
3.7	PG queried whether we were modelling both the effects of loss of transport infrastructure on other infrastructure modes and visa versa. AOC confirmed	Note

Item	Description	ACTION
	this was the case.	
3.8	PG noted that efficient and appropriate dissemination was critical and could have an important impact. He noted that in some of these projects 'dissemination' was considered to be just about publishing/presenting at conferences. He noted we need to have more targeted strategies in place. AOC noted that we had a dedicated dissemination partner who would put these strategies in place.	Note
3.9	PG and BB queried the frequency of the AB meetings. MT noted that 3 no. in total were scheduled (1 no. Per year).	Note
3.10	AOC queried whether AB would like to be 'proactive' or 'reactive'. General consensus was that AB would be Proactive.	Note
3.11	BB noted that WP leaders should be in attendance as it was important for AB to understand what work was being undertaken in each work package and the outputs that are being prepared. MT noted that this was the intention but difficulties in arranging the first meeting resulted in WP leaders not being present.	Note
(i)	LH queried whether it would be possible to circulate timetable of deliverables. MT to circulate Gantt chart or similar.	MT
(ii)	SM noted that AB members should be invited to Consortium Meetings.	Note
(iii)	MT noted that next Consortium meeting is in London on the 26 th March. This is too short notice but it was agreed that AB would attend the next meeting in 6 months time (September/October 2014). <i>This meeting to take place the day before the consortium meeting.</i> MT to circulate doodle poll to arrange this meeting in conjunction with Consortium meeting.	Note, MT
4.	Conceptual Modelling - GMA	
4.1	AOC presented GMA and an update on the progress. A discussion followed the presentation.	Note
4.2	MT to issue presentation to AB members.	MT
4.3	MT to issue updated GMA report to AB members.	MT
4.4	Difficulties associated with 'bounding' the problem were discussed.	Note
(i)	AOC queried whether focus question was too general or there were too many variables?	Note
(ii)	BB noted that we should rephrase our 'Focus Question' to include the word "Transport" into the definition.	Note
(iii)	SM noted that 'inputs' were too high level and the variables are too general. She also noted that the consortium should conduct a literature review of vulnerability and critical assessment and try to bound the problem using previous studies.	Note
(iv)	PG noted the "Lifelines" project for Wellington which produced a structured methodology to analyse individual elements. SM also acknowledged the existence of this project.	Note
(v)	PG acknowledged that we are considering complex risks. He noted that if we attempt to sub-divide this into single risks there will be difficulties.	Note
(vi)	PG queried our definition of resilience - AOC noted that we are considering resilience as referring to infrastructure which could continue to be in operation.	Note
(vii)	Referring to our GMA parameters presented, PG noted that no. 5 could be	Note

Item	Description	ACTION
	amalgamated with no. 2, no. 6 could be removed, No. 14 and no. 8 could be combined. AOC noted that there is an updated version of these parameters and we had considered how to reduce the number of parameters - It is critical to complete the latest GMA report and issue to AB members for comment (see note 4.3 above).	
(viii)	PG noted that "Critical Descriptor" column has too many sub options - It should be either critical or not critical.	Note
(ix)	In considering fixed land based infrastructure PG noted that we should only be considering 'local' or 'regional' level. We should not have various options (local, regional, national, EU etc.). Regional level and greater should only be considered under one heading.	Note
(x)	PG noted that we should consider a threshold to define a major impact at sub national or national scale.	Note
(xi)	BB queried how we decide on the seriousness of an event? We should associate consequences with the event. He suggested omitting any events which have consequential costs of < £/€ 1 million.	Note
(x)	PG noted that Martin Reiss was conducting research on extreme low probability events at Cambridge which could be worthwhile investigating.	Note
(xi)	AOC explained difficulties in bounding the problem and how we had considered a number of the general comments from the AB. One of the main issues was that it appeared we had too many variables and problem could not be solved using GMA, which works best with fewer parameters. PG questioned reasons we selected GMA and whether other methods existed to achieve our objectives. He noted that we need to justify the reasons for choosing this method. AOC noted that our conclusion could be that it is not possible to bound the problem.	Note
(xii)	PG noted the potential suitability of "Social Network Analysis" - in this case we would not have to bound the problem and could consider all interactions which would be ranked/prioritised rather than having to be omitted.	Note
(xiii)	EOB questioned the possibility of reprogramming the GMA software to allow us to deal with the problem of having to 'bound' the problem.	Note
(xiv)	PG suggested we start with a smaller matrix (maybe 5 columns, 5 rows) and work backwards based on case studies i.e. start the process using a less refined model and see what we may need to add as we develop case studies.	Note
5.	Case Studies	
5.1	MNC presented the case studies. A discussion followed.	Note
5.2	BB suggested to replace 'Embankments' with 'earthworks' in our definition of CI as 'cuttings' would also be included.	Note
5.3	PG suggested including 'structures' in the definition as 'culverts' and drainage structures would also be included.	Note
5.4	BB noted that we should concentrate on more than just bridges (e.g tunnels etc.)- MT noted that a bridge was just the starting pint and we are considering including tunnels at a later date.	Note
5.5	BB noted that it was important to concentrate on weak links within the network - what these are and where they are located.	Note
5.6	PG questioned use of return periods for hazards, particularly in relation to flooding, which have 'reduced' in recent times. MT noted that effect of climate change on return periods was being considered in WP2.	Note

Item	Description	ACTION
5.7	PG also questioned the use of IPCC for return periods.	Note
5.8	PG noted our case studies were very much inland. He queried whether we had considered the tunnel between Germany and Denmark. AOC noted that we had chosen case studies in regions which are subjected to multiple hazards.	Note
5.9	PG acknowledged that we probably selected case studies based on the location of the "red zones" in hazard maps. He is of the opinion that real low probability areas are indicated by "green zones" (i.e. historically less likely) on the hazard maps.	Note
6.	Implementation and Dissemination	
6.1	The importance of providing outputs (tools etc.) that can be understood and implemented by an organisations high level personnel (directors) was important.	Note
6.2	BB suggests the consortium should pay particular attention to our dissemination strategy - intended users typically won't attend conferences. We should be very specific in events we attend. We should target 1 or 2 specific conferences e.g the Surveyors Bridge Conference.	Note
6.3	EOB suggested we target policy makers first as this is more likely to ensure findings are filtered down the chain.	Note
6.4	BB believes that Network Rail has a group that looks at contingency planning and runs regular exercises with the emergency services and he thinks that the development of a successful tool may be of use to such people - its use to practicing engineers may be less obvious. PG noted that the tool be targeted at a higher level e.g Transport for London, Dublin City Council, or European and national governments. PG further added that city councils etc. might have a better understanding of complex risks.	Note
6.5	AOC noted that concessionaires were a target as privately financed projects will have insurances involved and as such will be a concern in the event of loss of functionality/operation etc. BB noted that in some cases transport infrastructure owners self insure for all but the most catastrophic events.	Note
6.6	PG noted that in terms of business continuity and planning systems, insurance companies' could be a potential target. PG queried whether we had approached insurance companies? MT noted that we had approached insurance companies but they had shown no interest in participating.	Note
6.7	BB noted that UIC could be very useful in assisting in dissemination activities as they produce guidance leaflets . MT noted that FEHRL will also be useful from a roads perspective. EOB noted that we could also try CEDR.	Note
6.8	BB mentioned the UIC's 'Panel of Structures Experts' (POSE) and The European Construction Technology Platform (ECTP) as potential avenues for dissemination.	Note
6.9	EOB queried whether dissemination material would be in languages other than English. MT to check.	Note, MT
6.10	AGM noted the IDRC Global Risk Forum conference in Davos in 2014 might be a good event to disseminate the work being undertaken.AOC noted that submitting papers might be too early but submitting a poster would be a good idea.	Note
6.11	MT noted that rather than targeting conferences related to hazards we should be targeting conferences more related to Critical Infrastructure - the audience may be more relevant.	Note

Item	Description	ACTION
7.	Software	
7.1	BB noted that the best means to distribute software was on a Microsoft platform and as freeware, though freeware has associated difficulties particularly with larger organisations (Largely due to IT security issues).	Note
7.2	Training in the use of the software will be important and how we attract people to attend the training (via targeted dissemination) will need careful consideration.	Note
7.3	PG questioned whether software could be developed sufficiently to the required level given the time and funding limits. Perhaps a prototype software will come out of the project and then the further developments will have to be self funded or additional funding sought (MT noted that TRL of H2020 could provide opportunities in this regard).	Note
7.4	EOB noted there may be an opportunity to commercialise the software if different countries were willing to adapt it for their use.	Note
8.	AOB	
8.1	BB noted that at the University of Surrey Helder Sousa is working under the guidance of Prof Marios Chryssanthopoulos as part of the Marie Curie ITN SmartEN on the identification of critical assets where there are multiple transport routes between key nodes. This work may usefully inform some of the thinking in INFRARISK.	Note
8.2	MT noted that travel and subsistence receipts for attending the meeting should be provided to ROD (to MT) for reimbursement.	Note