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NATURAL HAZARD EXPOSURE INFORMATION MODELLING FRAMEWORK

Annual project report 2014-2015

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Cover: Housing at risk from bushfire at the urban/rural interface.

Photo: David Bruce, Bushfire and Natural Hazards CRC.

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EXECUTIVE SUMMARY

Exposure is a word often used to describe "what is at risk" that includes people, buildings, infrastructure, businesses, hazardous substances and primary industries. The annual report is to outline the achievements of milestones of Bushfire and Natural Hazards CRC is funded "Natural Hazards Exposure Information Modelling Framework". The framework will support the development and maintainance of nationally consistent exposure information systems to support decision making in disaster management. The project has reviewed the current literature and information services; engaged end users and researchers for future requirements; and, is continuing the gap analysis.

The literature review has helped the project to understand the relevant practices and future trends at international, national, regional and local levels. In particular, the review highlighted the exposure data requirements to enable researchers to develop models for better impact analysis. The review has also contributed to collating the requirements for information needed by decision makers for response and strategic policy initiatives.

The project has conducted an on-line survey for the review of exposure information capabilities in Australia to ascertain existing data and information capabilities for DRR. The survey has identified significant gaps in the existing data provisions and translation of information for evidenced based disaster risk response, recovery and reduction decision making. Geoscience Australia's National Exposure Information System has a nationally consistent approach and provides exposure information for buildings and population. Most of the information is derived statistically and provided at SA1 aggregated level. Emergency Information Coordination Unit, NSW has comprehensive information for Sydney and limted information for other areas in their jurisdiction. The Census of Land Use and Employment (CLUE), Melbourne City provides comprehensive information about business and economic activity. Notwithstanding these examples, the overall lack of national consistency in existing data and information capabilities is a limiting factor in the decision making.

The project also conducted a Stakeholder Engagement Workshop with an aim to identify the exposure information needs of researchers and end users in Australia. The workshop provided an opportunity for thirty six participants representing decision makers, emergency managers, planners, researchers, asset managers and the insurance sector to outline their future requirements. Mind-maps presented at the workshop enabled us to observe overlapping concepts and data elements in the three exposure components of disaster exposure information. Stakeholder engagement is continuing with the researchers and subject matter experts. Recommendations were drawn to develop a standardised, nationally consistent and scalable natural hazards exposure information framework for Australia.

The collective views of data managers, researchers and end users have informed the basis for exposure information requirements to develop a consistent, standardised exposure information framework that will support vulnerability assessments for disaster risk reduction and socio-economic impact analysis.

END USER STATEMENT

Leesa Carson, *Branch Head, Community Safety, Geoscience Australia, Canberra*

The project has achieved the set milestones for 2014-15 with a slight delay in economic exposure information framework report.

An online survey was conducted in October-November 2014 to review the existing exposure information capabilities in Australia received nearly 50% response rate. Thirty-seven organisations were invited to participate with 18 organisations responding. The survey highlights gaps in data and information required for emergency management and risk assessment.

A successful workshop on national exposure information standards needs was held in Melbourne on 2 December 2014. Thirty-six of 45 invited participants attended, representing a wide range of end users and researchers. The workshop enabled participants to actively engage and made important contributions outlining their exposure information requirements.

From this workshop, high-level mind maps were developed for exposure information frameworks for buildings and infrastructure. These mind maps are important in enabling identification of additional areas of focus that may be considered in the development of the framework. The mind maps for buildings and infrastructure exposure information requirements were circulated to end users and researchers in March-April 2015 for review and comment. There has been limited input from end users outside of the workshops.

Business/Economic Activity Exposure Information Framework is highly significant component in the project. This component underpins the impacts assessment and consequences of disasters on business sector and also on the economy. As it is an important aspect to the project and providing a progress report would be beneficial.

Input from end users is important in providing a final product that will be useful and effective framework.

INTRODUCTION

What is the Problem?

Disaster Risk Reduction (DRR) is a systematic approach to identify, assess and reduce the risks from natural hazards. Exposure information is a fundamental requirement for decision-making in disaster mitigation. A nationally consistent, standardized terminology and comprehensive exposure information system to assist decision makers and researchers is not available in Australia. Geoscience Australia (GA) has developed a nationally consistent exposure information capability: 'National Exposure Information System (NEXIS)', to assist the development of risk assessment capabilities for GA's Community Safety program. However, NEXIS only has relevant and statistically derived information related to buildings and population. NEXIS is not comprehensive enough to support all hazards and levels of disaster management and does not provide for infrastructure and business sector exposure information.

Why is it Important?

Natural hazards have a profound impact on the Australian communities. The Hyogo Framework for Action (HFA, United Nations 2005) and subsequent national strategies such as the Australian National Strategy for Disaster Resilience (COAG 2011), highlight the importance of assessing risks and preparing for them. Communities are subject to the damaging impacts of disasters caused by destructive bushfires, floods, and severe storms. The impacts of these disasters on people, economy, infrastructure and environment remind us of the need to continue improving our resilience to disasters (COAG, 2011).

Current disaster preparedness strategies often focus on building resilience for known disaster risks. However, disasters are characterized by interdependent and systemic risks that can trigger cascading effects which are hard to predict. The 'unexpected' is already part of life for many communities. For this reason, there is an urgent need to investigate ways to prepare for what we are not able to predict or to communicate to the communities.

To address this issue and support disaster mitigation initiatives, provision of comprehensive exposure information is fundamental for risk assessments and to underpin decision making for disaster mitigation. An exposure information modelling framework is a significant step towards developing national exposure information capabilities for Australia.

How are you going to solve it?

After reviewing the existing exposure information systems that support disaster management, it is realized the existing information systems are not comprehensive enough and lack of consistency across the nation. Improvement in the availability of relevant, consistent and high quality exposure information will assist decision making in all phases of disaster mitigation such as planning, preparedness, response and recovery, at federal, state and local government levels. An exposure information framework assists in developing and promoting more unified national information capabilities within an appropriate conceptual framework.

Building on the existing NEXIS framework with the support of BNHCRC research funding, the project is preparing a comprehensive exposure information modelling framework and relevant standards. The framework will be designed to provide pathways to improve current capabilities by identifying key issues, needs, gaps, overlaps and deficiencies to build exposure information capabilities.

PROJECT BACKGROUND

A good understanding of the risk of natural hazards is vital to minimize their potential impact (Middlemann, 2007). An understanding of hazard, exposure and vulnerability is fundamental in any rigorous analysis of the risk posed by natural hazards. Exposure is the collection of elements at risk to potential losses or that may suffer damage due to a hazard impact. Exposure refers to the communities, businesses, services, lifeline utilities and infrastructure subjected to risk. Exposure information is fundamental in the development of risk-assessment models for natural hazards, lifeline and infrastructure failures and also consequences of climate change. Exposure data is also highly useful to underpin early warning systems and support national priority outcomes as described in the National Disaster Resilience Strategy (NSDR) referenced in COAG, 2011: Understanding risks; reducing the risks in the built environment; and, supporting capabilities for disaster resilience. To be effective the framework should be aligned with the National Emergency Risk Assessment Guidelines (NEMC, 2014).

GA has developed the National Exposure Information System (NEXIS), which provides exposure information about building attributes at a range of resolutions (Nadimpalli, 2007). NEXIS provides physical exposure such as building counts as well as statistical aggregations of buildings at different geographic areas to assess the quantitative risk from natural hazards. NEXIS development was initiated in response to the Council of Australian Governments Report (COAG, 2003) to establish a nationally consistent system of data collection, research and analysis to ensure a sound knowledge base on natural disasters and disaster mitigation. The aim of developing NEXIS was to support GA's risk assessment capabilities and the Government's climate change adaptation policy framework. NEXIS information has supported several climate change adaptation initiatives including climate change risks to Australia's coast.

Decision making at all levels of the disaster governance process is very complex and depends on multiple attributes, objectives, criteria and functions. A nationally consistent exposure information framework for natural hazard risk reduction provides pathways to strengthen existing information capabilities such as NEXIS and forms the basis of an essential element for decision making.

WHAT THE PROJECT HAS BEEN UP TO

The Bushfire and Natural Hazards CRC is funding the preparation of an exposure information modelling framework to identify fundamental information requirements for better evidence based disaster management. The framework will underpin the development of a comprehensive natural hazards exposure information base to assist in reducing the natural hazards risk to communities. Implementation of the framework will help to understand the exposure of people, buildings, businesses and infrastructure to natural hazards. Current exposure information provision capabilities have been reviewed to identify key issues, needs, gaps, overlaps and deficiencies. A stakeholder engagement workshop was convened to identify future information needs and to understand the trends by aligning with broader framework objectives of the National Emergency Risk Assessment Guidelines.

The following are four distinct, but interrelated components of built environment exposure identified through extensive reviews and stakeholder consultation.

- Information on population
    - remoteness, density, mobility, socio-economic status, age profile, disability status, indigenous and ethnic composition and proportion of floating and tourist population
    - time dependence of population, population evacuation speed, information on factors that influence human risk perception and information on existing network organisations and community groups are important for exposure information modelling.
- Information on Buildings
    - building type, code/standard, age, location, location by the exposure categories
    - number of storeys, floor height, elevation, orientation, façade coverage and material use
    - ancillary buildings
- Information on infrastructure
    - roads, bridges, airports and seaports; power distribution networks; underground water supply networks
    - lifeline and connected infrastructure.
- Information on business and land use
    - location of operations, type, employment, turnover, size, value and costs
    - primary industry – agriculture, horticulture, cattle
    - land use practices and crop calender

The project report on information requirements, available sources, gaps and strategies is being prepared for the built environment and business exposure framework. The report is progressing on schedule with the exception of the

business exposure framework component which has been delayed by two months.

LITERATURE REVIEW

The project team conducted a comprehensive literature review at the beginning of the project. This was a significant input to understand the current trends in international literature on natural hazard exposure information frameworks. However, the international literatures are mostly focused on hazard modelling at specific country level. In Australia, this literature review identifies the documents related to initiatives and research undertaken at the respective local, state and federal government level. However, there is no comprehensive framework for natural hazard exposure information modelling is available to adopt for building exposure information system at a national level. Further, this review identifies that the National Exposure Information System - NEXIS (Nadimpalli et al, 2007) framework is an important starting initiative for developing comprehensive national exposure information modelling framework. Geoscience Australia has provided advice and part of developing Global Exposure Database though this model is at the global scale and good reference to follow.

The literature review found that beside direct physical damages (mostly, proprietary), indirect losses have also been identified to have significant effects on business vulnerability. This also suggests that enabling the business community to be aware of the vulnerability of their businesses is a powerful approach towards mitigating the effect of a disaster.

The literature review further identifies important aspects of built environment and business exposure information requirements that would form different components of the Bushfire and Natural Hazards Exposure Information Modelling Framework and improve information for disaster risk mitigation capabilities.

REVIEW OF EXPOSURE INFORMATION CAPABILITIES

The review of exposure information capabilities or systems in Australia is an important component of this project. To achieve this Geoscience Australia (GA) conducted a national level survey of exposure information capabilities in October-November 2014, to ascertain already existing data and information capabilities in Australia for DRR decision making. The survey enabled GA to review the current practices and perform gap analysis to enhance authoritative data/information for emergency planning, preparation, response and recovery.

The exposure information capabilities in Australia have been selected from a list of key stakeholders who provide information for the emergency response and recovery. The survey has been sent to 37 organisations including federal and state level government departments and insurance sector out of which only 18 capabilities have responded. Insurance sector did not responded to the survey and this may be due to confidentiality. Anyway, the information from this sector is not available in the public domain.

The survey was categorised into three exposure components to review the information availability and accessibility provision to researchers and end users.

1. Building and Demographics
2. Infrastructure
3. Business/Economic Exposure

Further to the survey several datasources were explored for sources of exposure information that includes Census of Land Use and Employment of City of Melbourne, Australian Business Register, Bureau of Resources and Energy Economics, Australian Bureau of Agricultural and Resource Economics and Sciences, Australian Chamber of Commerce and Industry, and Bureau of Infrastructure, Transport and Regional Economics. This is highly useful piece of knowledge for identifying the information gaps in the disaster management practice in Australia.

STAKEHOLDERS' ENGAGEMENT WORKSHOP

The Stakeholder Engagement Workshop was held on 2nd December 2014 at Melbourne, where decision makers, emergency managers, planners, researchers, asset managers and data custodians attended the workshop. The objective of the workshop is to gain a better understanding of exposure information requirements, identify impediments and strategies to overcome the impediments. The workshop provided an opportunity for attendees to contribute to the advancement of existing capabilities by providing their future requirements.

This stakeholder engagement workshop was aimed at:-

- Reviewing the current exposure information capabilities for decision makers and researchers;
- Obtaining the perspective of current and potential users on their current and future information needs and opportunities;
- Broadening the engagement of researchers, whole of government, industry and data custodians; and,
- Enabling the expansion of the scope of this framework for the development of information capabilities and their road map.

Overall the workshop facilitated had a stimulating discussion on issues concerning how to develop a standardised, nationally consistent and scalable natural hazards exposure information framework for Australia. The discussion in break-out sessions generated many useful ideas to identify current and future data needs in line with the three broad categories of the draft framework as buildings and demographics, infrastructure including critical and lifeline infrastructure and their interconnectivity and business and economic exposure.

Mind maps presented at the workshop and follow-up discussions helped to identify overlapping concepts and data elements in the buildings, business and infrastructure exposure categories. Further, there are strong linkages between these three categories as an integrated system or a system of systems. In other words, people shape communities who occupy buildings either for business or living purposes. The infrastructures connect the communities and provide services for building and other sectors like transport. Analysis of preparedness,

response and recovery before, during and after disasters are to be taken into account in system of systems. The workshop provided a basis for types of economic analysis needed by researchers and the data requirement of the end users.Therefore, the exposure information framework considered to be designed in the context of a system of systems.

EXPOSURE INFORMATION FRAMEWORK REPORT

Business and Economics exposure information framework report is being prepared by the University of Melbourne. The submission of the report is scheduled to be completed by 30 June 2015. This milestone is delayed by one month. University Melbourne has a prepared business and economic exposure information needs and sources of information.

Built environment exposure information framework consists of buildings, people and infrastructure is progressing well. Geoscience Australia has collected all relevant information required for the framework and the draft report is in progress.

PUBLICATIONS LIST

Nadimpalli, K., 2014 Natural hazards exposure information modelling framework, AFAC 2014 Conference, Wellington. (Abstract)

Nadimpalli, K., and Mohanty, I. 2015 Exposure information modelling framework – a path to disaster risk reduction, ANZ Disaster & Emergency Management Conference, Gold Coast. (Abstract)

Nadimpalli, K., and Mohanty, I. 2015 What is in the disaster zone?, AFAC 2015 Conference, Adelaide. (Abstract)

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