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NATURAL HAZARDS EXPOSURE INFORMATION FRAMEWORK

Annual Project report 2015–2016

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Cover: This research is helping emergency managers to understand what infrastructure is at risk from natural hazards.

Photo: Victoria State Emergency Service.



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EXECUTIVE SUMMARY

Exposure in Disaster Risk Reduction (DRR) describes as “what is at risk” that includes people, buildings, infrastructure, businesses, hazardous substances and primary industries. Exposure information comprises the details needed to support situational awareness at all levels of governance and in various phases of disaster management. There is plenty of fundamental data on assets exposed to natural hazards is available with many data custodians including ABS (Census), GA (NEXIS), ABR (Business Registry), NSW (EICU, ESSIL), QLD (redi-EXPOSURE), Melbourne City (CLUE), and Insurance portfolio in the sector.

The available data has inconsistency in resolution, definitions, geography, and seamless features across administrative areas and access conditions of the exposure information for the end users. The current information provision capabilities have the lack of comprehensive exposure attributes, standards, centralised database, access infrastructure and inventory strategies.

Extensive literature review and stakeholder consultations were conducted to identify comprehensive list of information requirements. The project has conducted an on-line survey with many data custodians who provide the exposure data to end users. Current exposure information capabilities are developed in isolation at national, state and local level or are industry specific.

The Natural Hazards Exposure Information Framework is to provide guidelines for the information system development in a nationally consistent way and provide access for diverse users. The annual report outlines the achievements of the project and its milestones. The project has completed built environment exposure information framework as a major milestone. The business exposure information framework is delayed and likely to be completed by September.

The framework presents the details of exposed assets to natural hazards as components, elements and attributes. The exposure components considered in the framework are buildings, people, businesses, transport sector, energy sector, communication sector, potable water, major industries, primary industries and waste management. The exposure elements outlined for each of the components as assets, usage and value categories. The elements are further outlines as standard set of data attributes required for researchers and decision makers. The level of details required for end users vary, therefore the framework categorises the information provision into three levels depends on user requirements such as policy & planning; Response & Recovery; and research analysis.

The framework outlines fundamental information category which is common for all exposure components that includes location; broad land use; insurance status and metadata.

Built environment information framework considered the attributes of fixed assets and associated activities information to assess the vulnerability from the impact of bushfires, natural hazards and malevolent acts. The buildings exposure considered usage, type, structural system, number of storeys, size, age, attachments, replacement value and contents value. The infrastructure sectors considered in the framework includes transportation, energy, communication,



urban water supply, waste management, hazardous substances and major industries. The primary industries exposure considered agriculture, fishing, forestry and mining sectors.

The Business and Economics Exposure Framework consists of business definitions, assets and activities information which are deemed necessary for assessment of business continuity, disruption, resilience and recovery indicators in disaster management.

Stakeholder engagement roadshow is progressing in most of the states. This is to present the framework for endorsement and draw better utilisation strategies. Reliability information framework is also being prepared to maintain the data provenance and enable the systems to provide advice on reliability of the information for a specific use. The situational awareness of the exposure is critical to manage the economy and community safety.



END USER STATEMENT

Leesa Carson, *Geoscience Australia*

This project has developed a nationally consistent built environment information framework for Australia. The framework presents detail of key components, elements and attributes of the built environment.

The project is on track, with one milestone (business exposure framework) being deferred until September 2016. Business Exposure Information Framework is a significant component in the project which will underpin the impacts assessment and consequences of disasters on business sector.

The project team has commenced an end users and stakeholder communication campaign to seek feedback for the framework implementation and identify opportunities for utilisation.

The project needs to develop a communication plan with communication experts, which may assist in developing approach to communicating a complex project and the value of the outputs.



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 situational awareness in disaster management. A nationally consistent, standardised 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. There are many other organisations maintain their own datasets to support specific programs. There is no national consistent, comprehensive, authoritative, robust and reliable information accessible for all natural hazards and all levels of governance.

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 characterised 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.

There is a need to develop a framework to prepare guidelines for national consistency to provide situational awareness and support disaster management initiatives, provision of comprehensive exposure information is fundamental for risk assessments and to underpin decision making.

How are you going to solve it?

An exposure information framework that supports all hazards is a significant step towards developing national exposure information capabilities for Australia.

Literature review, stakeholder engagement workshops and consulting experts will enable the project to prepare a framework that consists of comprehensive exposure information needs. The exposure information list comprises of buildings, people, infrastructure sectors, industries, business, economic and primary industries. Further a review on existing exposure information systems to be conducted to understand the current practices that support disaster management. This process will enable the project to highlight the gaps and priorities. Based on the experiences, 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 planning, preparedness, response and recovery of DRR and to respond at federal, state and local government levels. An exposure information framework will assist in developing and promoting more unified national information capabilities.

The information available may not be suitable for diverse range of activities and levels of governance. The project is preparing a reliability framework for the end users to understand the provenance of the data and its reliability for their specific use.

This comprehensive framework provides guidelines to the exposure data custodians to build nationally consistent, robust and reliable exposure information systems for the nation.



PROJECT BACKGROUND

A good understanding of the risk of natural hazards is vital to minimise 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 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. 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. 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

This research project to develop an Australian Natural Hazards Exposure Information framework is funded by Bushfire and Natural Hazards CRC (BNHCRC). The annual report outlines the achievements and progress of the project milestones in 2015-16.

The project has completed the literature review and Stakeholder Engagement Workshop 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 in collating the requirements for information needed by decision makers for response and strategic policy initiatives. The project has conducted an on-line survey of existing exposure information capabilities in Australia to ascertain existing data and information capabilities. The survey has identified significant gaps in the availability of existing data and the translation into meaningful information for evidence based disaster decision making.

The project has completed the built environment exposure information framework as a major milestone. The framework seeks to address the complex nature of end users needs and the wide range of information required at varying resolutions. To reduce the complexity, the framework categorises the information into three levels depending on user requirements such as policy and planning; response and recovery; research and analysis.

The framework presents the fundamental characteristics of exposed assets to natural hazards as components, elements and attributes. The exposure components considered in the framework are buildings, people, businesses and infrastructure.

Three data elements are considered fundamental to all exposure assets. This includes location, insurance status and metadata. The location element is a common reference for the exposure data inventory, analysis and dissemination and this provides situational awareness for decision making. Disaster affected communities face a huge task in rebuilding assets and businesses as well as supporting people. Insurance payments are significant financial contributors to rebuilding and resilience efforts. Knowing the levels of insurance cover will help people, businesses, asset managers and governments develop better resilience following a disaster.

Buildings and infrastructure related assets and their operation are considered as part of the built environment information framework. The details of the building characteristics including usage, type, structure system (foundation, internal frame, external walls, façade, roof, height etc.), size, age, utility connections and replacement value are required to analyse and assess the likely impact and risk from natural hazards.

Australian communities are varied in their composition and in their level of exposure to disaster risk. This can be greatly affected by the exposure of infrastructure assets that form the transport sector, energy sector, communication sector, potable water, major industries, primary industries and waste management systems.



Exposure elements in transportation infrastructure are divided into assets, vehicles and operations covering four modes of transport: air, rail, road and water. Transport assets consist of fixed installations including roads, railways, airways, waterways and terminals such as airports, railways stations, bus stations, warehouses, fueling stations and seaports.

The energy infrastructure sector consists of the industries involved in the production and distribution of liquid fuels, gas and electricity. The communications infrastructure component considers the services of telephones, mobile services, internet, national broadband network, international submarine cables, broadcasting (mass communication) and postal services. Australia's national security, community safety, economic prosperity and social well-being increasingly rely on telecommunications networks.

Urban Water supply and sanitation is the provision of water by public utilities and commercial agencies for domestic and industrial use, usually via a system of pumps and pipes. Irrigation for agriculture is not covered in this section. The primary industries sector includes agriculture, fishing, forestry and mining.

The exposure framework has broadly classified the factors that can influence the level of population vulnerability to natural hazards into the following key indicators: Remoteness Status, Demographic Composition, Socio-economic Status, Labour force Status, Health, Ambient Population, Risk Response and Social Capital.

The business-economic exposure is categorised for micro- and macro- economic analysis. The information requirements for micro- economic analysis or business continuity is primarily at the asset level with details such as type, revenue, cash flow, employees, size, diversity, assets and liabilities, etc, required. Whereas the elements identified at the national level are intended for macro-economic level analysis about the impacts of natural hazards on the nation's Gross Domestic Product.

A sample of the exposure framework for the buildings exposure attributes is listed in table 1. Similarly, all other sectors are presented in the framework report which is available at <http://bnhrc.com.au/publications/biblio/bnh-2701>

The framework has prepared a list of known data sources to collate the exposure information which also enables the identification of gaps for all exposure components listed above. A number of these gaps are highly critical and should be to be prioritised for future development. For example, the emergency sector is relying on Australian Bureau of Statistics (ABS) population demographics which is a census night population and that does not provide information in the day time for a rapid on set of events like earthquakes.

The next phase of the project will utilise expert knowledge gathered through individual engagement in each jurisdiction with end users, researchers and data custodians to define the exposure to attribute level for each of the elements and typologies (a combination of exposure elements). Attribute definitions and standard terminology for buildings, infrastructure, businesses and population exposure elements will be included in the final framework report.

The jurisdictional visits also provide an opportunity to discuss opportunities for utilisation and endorsement of the framework for implementation. To date, the



project has completed visits to Queensland (Queensland Reconstruction Authority, Queensland Fire and Emergency Services, Department of Natural resources and Mines) and NSW (Rural Fire Services, Emergency Information Coordination Unit, State Emergency Services and other agencies). Further consultation will continue in the other remaining states and territories.

Table 1. List of exposure attributes of buildings

BUILDINGS							
Usage	Type	Structure System	Year Built	Size	Emergency Exit	Utility Connections	Replacement Value
Residential	Separate house	Foundation	Built Year	Land size	Signage	Location of Gas	Building Value
Commercial	Semi-detached house	Internal Frame	Construction Period	Gross Floor Area	Evacuation Floors	Location of Electricity	Contents Value
Light Industrial	Apartment - Low Rise	External Wall	Retrofit Year	Building Lettable Area	Evacuation Lifts	Location of Water	
Educational	Apartment - Medium Rise	Roof Shape	Renovation Year	Number of Dwellings	Evacuation Stairwells	Location of Solar	
Health & Welfare	Apartment - High Rise	Roof Type	Year	Extensions	Evacuation Plan	Location of Hydrants	
Emergency-Services	Multistorey	Floor Type		# Bedrooms	Code		
Government	Commercial	# Storeys		# Toilets	Regulations		
Community	Commercial	# Basements		# Car Parks	Problems		
Recreational	Commercial	Attachments		Size of Garage			
Mixed Use	Buildings	Building Standard		Annex buildings			
	Shopping Mall	Standard					
	Complex	Emergency Exit					
	Agriculture Sheds	Utility Source					
	Warehouse						
	Light Industrial Buildings						
	Parking Structures						
	Religious Buildings						
	Heritage						
	Heavy Industrial						
	Multiple Buildings						
	Public Venues						



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Nadimpalli, K., and Mohanty, I. 2015 Built Environment Exposure Information Framework, Milestone Report, <http://bnhcrc.com.au/publications/biblio/bnh-2701>

Nadimpalli, K., and Hay, R. 2016 Natural Hazards Exposure Information Framework – A step towards improving disaster management capabilities, ANZ Disaster & Emergency Management Conference, Gold Coast (Abstract)



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