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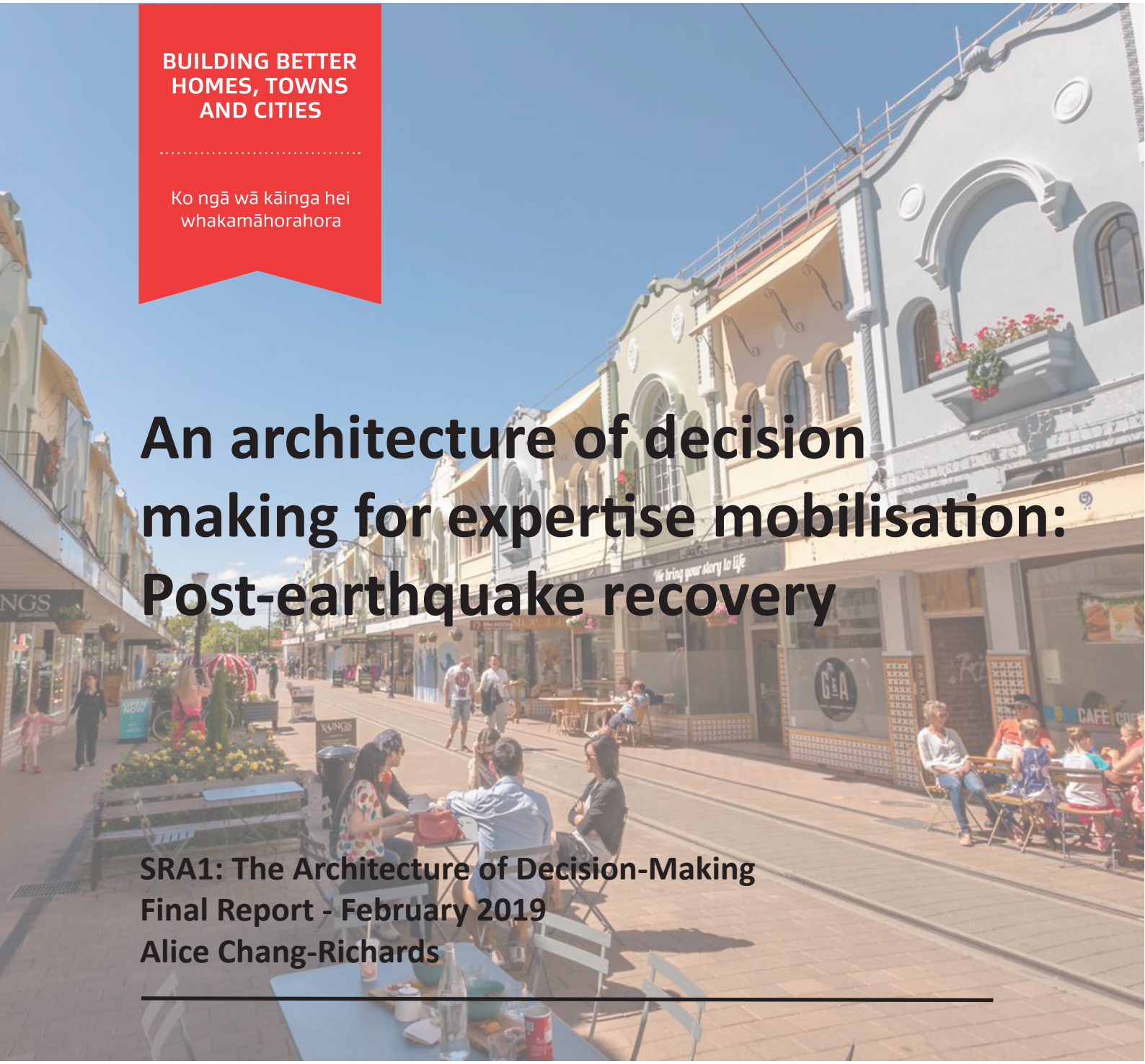

# An architecture of decision making for expertise mobilisation: Post-earthquake recovery

SRA1: The Architecture of Decision-Making
Final Report - February 2019
Alice Chang-Richards

# SRA1: Making the Architecture of Decisions Work

# Christchurch Recovery and Rebuild – Issues of Capacity and Capability


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### Disclaimer


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## Contents

**Abstract**

Disasters are often unexpected and cause widespread disruptions to communities, networks and infrastructure. A paramount aspect to the response and recovery of an event is the speed of mobilising resources and expertise, which can be hampered by ineffective decision making processes. This research aims to understand how relevant expertise resident in New Zealand was mobilised or not, the actors and logics associated with engaging expert advice, and the extent to which key actors were able to utilise that advice in a systematic way. By using the 2010/11 Canterbury earthquakes and 2016 Kaikōura earthquake as case studies, combined with a mixed approach for data collection, this research revealed the pathways through which knowledge and expertise from the Canterbury earthquake response and recovery had been transferred to support the recovery from the Kaikōura earthquake. A number of common issues of capacity and capability in both events included a shortage of certain professional roles, the influx of international knowledge during the recovery stage and a need for an information system that can be used for disaster response and recovery from future events. It was suggested that decision making in the post-disaster environment could greatly benefit from such a system that contains relevant profiling information of experts in the field. Through analysing common network links of professionals, the system would need to use LinkedIn or a web-based database to best capture expert knowledge for effective decision making in future events.

**Keyword**: Post-earthquake recovery, expertise, knowledge, Christchurch, Kaikōura

**Abbreviations**

CCC - Christchurch City Council

KDC - Kaikōura District Council

CERA – Canterbury Earthquake Recovery Agency

NZTA – New Zealand Transport Agency

SCIRT – Stronger Christchurch Infrastructure Rebuild Team

NCTIR – Northern Canterbury Transport Indrastructure Recovery

CCDU - Christchurch Central Development Unit

PMO – Project Management Office

ECRC – Environment Canterbury Regional Council

MCDEM - Ministry of Civil Defence and Emergency Management

CDEM - Civil Defence and Emergency Management

MoT – Ministry of Transport

## 1. Introduction

### *1.1 Project background*

This component of SRA 1 focuses on the dynamics around recovery post-earthquake in Christchurch with a particular focus on the way in which relevant expertise resident in New Zealand was mobilised or not, the actors and logics associated with engaging expert advice, and the extent to which key actors were able to utilise that advice in a systematic way.

### *1.2 Problem statement*

There is a need for attention to be paid to decision making for post-disaster response and recovery, due to an increasing number of disasters over the past decade (Escaleras & Register, 2011; EM-DAT, 2018). Natural disasters cause a wide range of destruction and physical damage to infrastructure, as well as distress and insecurity to those affected. A key step preparing for an unexpected event, such as the 2010/11 Canterbury earthquakes and 2016 Kaikōura earthquake that took place at the doorstep of New Zealand, is the ability to quickly identify and mobilise relevant expertise to aid with key decision-making during the time of crisis and uncertainty. The compressed nature of post-disaster timeframe requires decisions to be made with a high degree of skill and speed to ensure a successful recovery process (Olshansky et al., 2012).

New Zealand has a wealth of expertise and knowledge in the STEM (science, technology, engineering and mathematics) industries. Access to these can vary considerably in the aftermath of a natural disaster (Mclean, Oughton, Ellis, Wakelin, & Rubin, 2012). After each disaster, a wide range of experts are required to rebuild and reassure the affected population. These include upper level decision-making leaders from the government, design and construction experts for infrastructure recovery and welfare and community support professionals. Chang-Richards et al. (2017) suggested that from the initial earthquake response to longer-term reconstruction, activities such as initial and

detailed assessment of building safety and damage, emergency repairs for restoring basic utility and service functionality, and restoration of damaged infrastructure and housing, all require sufficient engineering and construction tools, processes and human resources with appropriate skills and knowledge. Therefore, having access to industry professionals, regarding post-disaster disaster management, is vital for a successful recovery.

The role human resources, especially those expertise specialised in disaster response and recovery, play in a disaster setting has been well recognised (Haigh et al., 2006; Chang et al., 2011). Longitudinal studies undertaken by Chang-Richards et al. (2012, 2013, 2014, 2015, 2017) unveiled the resourcing issues and capacity constraints faced by the engineering and construction sector that had affected the cost and time of rebuilding Christchurch following the 2010/11 earthquakes. To improve decision making for expertise mobilisation in responding to future natural hazard events affecting New Zealand's built environment, it is necessary to learn from the Christchurch earthquakes and Kaikōura earthquake. This report presents a post-earthquake assessment of what information sources about relevant expertise was available, useful, where it came from, how it was transferred between organisations, and how such information might be managed and used to improve expertise mobilisation across the recovery sector in the future.

### *1.3 Project objectives and deliverables*

Building on previous studies, the research reported in this report seeks to

1) Observe and identify the resource mobilisation mechanisms by which the post-earthquake decision makers, recovery organisations and construction and engineering sector responding to earthquake-related damages
2) Understand how expertise was utilised by actors and the logistics associated with their engagement so that lessons can be drawn from the event to improve how we manage, plan,

and utilise expertise and skills available in New Zealand

3) Identify measures for ongoing and future expertise identification. This may include recommendations around how best to drawn upon exisiting web-based expertise information and developing a case for a centralised database to share information that can be accessed by different sectors and organisations in times of crisis

To address these aims, three key project tasks were planned and conducted:

1) Data collection interviews with key actors
2) Focus groups with professionals in Christchurch City Council and Kaikōura District Council
3) Extended consensus workshop, further developing the project outcomes

It needs to be noted that this report is compiled from the views of multiple public and private organisations involved in post-disaster response and recovery from the 2010/11 Canterbury earrhquakes and the 2016 Kaikōura earthquake. It offers a range of perspectives and reflections across government agencies and construction and engineering sector about expertise identification and utilisation in post-quake response and recovery. This report is not a comprehensive review of New Zealand's disaster management system or incident command procedures. Although the focus groups and interviews were designed to capture as many experiences and perspectives as possible across the key actors, findings do not represent views of all post-disaster recovery participating organisations.

The study was undertaken by using the 2010/11 Canterbury earthquakes and 2016 Kaikōura earthquake as case studies. A mixed approach was used, namely, a combination of quantitative and qualitative methods, for collecting data from relevant industry professionals who were involved in the decision making process or recovery acticities in the two events. An architectural protocol of how the decisions were made and expertise were mobilised for earthquake recovery was developed from case studies. An information system which can draw upon functionalities of exisiting web-based

expertise database, such as Linkedin, was suggested as a potential tool to aid with decision making of resource mobilisation for future disaster recovery.

### *1.4 Report structure*

The introduction (this section) outlines the project rationale, scope, objectives and key deliverables. Section 2 and Section 3 focus on providing background information about the impact of the Canterbury earthquakes and Kaikōura earthquake, respectively, describing key decisions made post-event and remaining challenges. Section 4 summarises the review of literature relevant to the topic. Section 5 describes the methodology used for data collection and analysis, followed by the results in Section 6, which focus on analysis and discussion relevant to the recovery expertise mobilisation mechanisms, capacity and cability constraints, and future development of a post-disaster expertise database for recovery. This section proposes a protocol of such an expertise database which shows the flow of information through a network of organisations and exisiting tools like Linkedin that facilitated decision making in the aftermath of a disaster. Future research and programme development to develop an information system may build on the results presented in this report. Finally, appendices include transcribed interview notes.

## 2. The 2010/11 Canterbury earthquakes

The Canterbury earthquakes series of 2010 and 2011 had numerous events, with the significant ones being the $M_w$7.1 Darfield earthquake on 4 September 2010 and the destructive $M_w$6.3 earthquake on 22 February 2011 which caused many buildings to collapse and loss of 185 lives (GNS Science, 2011). The earthquake on 22 Feburary 2011 also caused widespread liquefaction that resulted in the need for substantial land review and zoning across the Christchurch city (Environment Canterbury Regional Council, 2012). In total, 1,021 km of road needed rebuilding, which accounted for 52

percent of Christchurch's urban sealed roads. The earthquakes also damaged 51 km of water supply mains and 528 km of the sewer system (CERA, 2012a). At the end of 2012, the total capital cost of the reconstruction was estimated to be between NZ$20 and $30 billion. The estimated costs for rebuilding different sectors are shown in Table 1 below. As more precise information is becoming available, the latest figures, released on 28 April 2013 by the Government, suggested that the reconstruction could reach NZ$40 billion with high levels of uncertainty remaining. This damage is equivalent to 19 percent of New Zealand's GDP.

Extensive damage and impact from the earthquake sequence had warranted significant disaster management protocols and direct interventions from the New Zealand Government. The initial protocol step that was required to be taken post the earthquakes was the implementation of the Civil Defence Emergency Act 2002. In April 2011 the central government passed *the Canterbury Earthquake Recovery (CER) Act* as new legislation to guide the overall recovery process in Canterbury. The Act also empowered the establishment of the Canterbury Earthquake Recovery Authority (CERA) as a primary agency overseeing overall recovery and reconstruction.

Following the February 2011 earthquake, the New Zealand government recognized the need for a different approach to deliver the horizontal infrastructure reconstruction. The Government sought guidance from the New Zealand Transport Agency (NZTA) on an appropriate response in restoring the earthquake damaged infrastructure. Experienced in alliancing-based project delivery, NZTA supported the alliance approach, believing that it would deliver with the speed required in comparison with other possible models (Office of the Auditor-General, 2013). The policy response to the task of horizontal infrastructure[i] reconstruction was the creation of the Stronger Christchurch Infrastructure Rebuild Team (SCIRT) with a mandate until the end of 2016. SCIRT adopted an alliance-like project

management model to deliver the recovery of horizontal infrastructure projects. It was designed to help facilitate the repair of key pieces of infrastructure (Liu, Scheepbouwer & Giovinazzi, 2016).

A statement by the Greater Christchurch Group and the Department of the Prime Minister and Cabinet highlighted that CERA's purpose was never to be the sole decision-maker for Christchurch recovery. An investigation into its institutional arrangements and governance revealed that Project Management Offices (PMOs) established in the different sectors (Chang-Richards & Wilkinson, 2017), such that

- Insurers' PMOs for managing housing repairs and reconstruction (e.g. EQC's EQR)
- SCIRT for infrastructure recovery : An alliance between asset owners (Christchurch City Council (CCC), CERA, and NZTA) and five delivery teams (City Care, Downer Construction, Fletcher Construction, Fulton Hogan and McConnell Dowell)
- Christchurch Central Development Unit (CCDU): A partnership between Central Government (through CCDU within CERA), the Christchurch City Council (CCC) and other groups to focus on rebuilding Christchurch's CBD Commercial buildings in the CBD

Dispite significant efforts made by the New Zealand government and agencies, a report by Simons (2016) noted there was limited public consultation on how the recovery should be proceeded. Simons research later found that when asking about their perception of Christchurch recovery, 81.3% of 428 surveyed residents were "very unsatisfied" or "somewhat unsatisfied" with the earthquake recovery. The lack of satisfaction was mostly related to insurance payout, perceived lack of support and general speed of recovery. There was also a common view that a diverse range of expertise and skilled professionals is required to create what is perceived as an efficient and effective post-disaster management (Simons, 2016).

## 3. The 2016 Kaikōura earthquake

When the Mw 7.8 earthquak struck Kaikōura on November 14th, 2016, the recovery of horizontal infrastructure and residential propertieis in Christchurch was near completion. The earthquake caused two deaths (MCDEM, 2016a) and 580 earthquake-related injury claims (ACC, 2017). Damage to transport infrastructure was the most severe impact of the earthquake. Both roads and bridges in North Canterbury and Marlborough were significantly damaged by 345 fault ruptures and shaking, liquefaction, and slumping induced damage (Stevenson, 2017). Landslides created access issues throughout the affected region. In particular, several large (100,000 – 500,000 $m^3$) landslides blocked both State Highway (SH) 1 and the South Island main trunk railway to the north and south of the Kaikōura district (Little, 2016). The town of Kaikōura was completely cut off along both coastal and inland routes for two days until military access for four wheel-drive vehicles was established along SH 70 on 16 November for the delivery of critical supplies (MCDEM, 2016b).

The North Canterbury Transport Infrastructure Recovery (NCTIR) was set up by the New Zealand Government late December 2016 to restore the earthquake damaged infrastructure between Picton and Christchurch. Similar to the infrastructure recovery experience with SCIRT in Chirstchurch, NCTIR is an alliance partnership between the asset owners (NZ Transport Agency and KiwiRail) and four delivery teams (Downer, Fulton Hogan, HEB Construction and Higgins). The selection of the four main contractors to be non-owner participants was not a competitive process carried out for NCTIR. The owner participants made this decision due to the contractors' local presence and their track record.

Overall, there were positive views about the response to the Kaikōura earthquake. According to Wotherspoon et al. (2018), the good practice that assisted the effective communication of information and data was the establishement of relationships with key partners prior to the event which meant that actors knew who to contact for advice or data. This improved the efficiency with which actors could

develop their responses and enhanced their ability to coordinate with others. For example, organisations such as the port companies, KiwiRail, and NZ Transport Agency needed rapid access to technical experts to conduct assessments. Having relationships and agreements in place prior to the event allowed them to be identified and pulled from their regular roles as soon as possible. Similarly, the establishment of NCTIR was assisted by staff directly transitioning from SCIRT.

## 4. Relevant theoretical context

### *4.1 Knowledge management*

Understanding the theory of knowledge management is essential for understanding how knowledge can potentially be managed post-disaster. The definition of knowledge management is dependent on the context and the author (Blackman, Kennedy, & Ritchie, 2011). The goal of knowledge management is to capture, create and distribute knowledge so that it can be shared effectively (Mcelroy, 2000). Blackman et al. (2011) suggested that it is the human part of knowledge management that has developed more in recent years. It is this part of knowledge management that is relevant and important for the context of this research. It is important to comprehend that knowledge management is the management of people's current systematic knowledge rather than the management of the creation of knowledge or the management of people (Wiig, 1997).

A more refined definition of knowledge in the current business world is "Knowledge management is an area of managerial concern that involves systematic leveraging of data, information, skills, expertise, human capital and various forms of intellectual assets for enhancing corporate productivity, organisational effectiveness, business innovation, competence and responsiveness." (Callaghan, 2016). Callaghan's definition of knowledge management touches on the importance of knowledge to

responsiveness. Although Callaghan's definition pertains to business problems, it also helps to understand the readiness of disaster management systems.

In specific relation of knowledge management to disaster management, knowledge management is vital for survival during times of change (Yates & Paquette, 2011). Yates and Paquette outlined some essential needs of knowledge management as a system for improving decision-making post-disaster, stating that such systems must be flexible to adhere to unexpected events and resilient enough to solve complex issues associated with each unique situation. As an information system, knowledge management has the potential to enhance emergency preparedness in disasters (Raman, Ryan, & Olfman, 2006).

### *4.2 Information Management*

Similar to knowledge management, information management is a conceptual term that has various meanings and interpretations from different sources (Detlor, 2010). The definition that Detlor provides is that information management is the management of processes that create, store and distribute information. The goal of information management is to organise information in such a way that it is readily available to people in an efficient and effective manner. At this stage, it is important to understand the difference between knowledge and information, as both have similar definitions. "Information is external to the individual in the form of printed or verbal communication. Knowledge exists as a reservoir in the brain to be tapped into in a time of need. Information becomes knowledge only when it can be incorporated into a personal logic system that allows it to be used in an appropriate fashion for contemplation or action." (Cohn, 1996).

Relating information management to disaster management, there are two scenarios when it can be applied; in preparation and in recovery. Research shows that governments are unwilling to spend money and resources on information management for the planning of large scale events

(Vatenmacher, Isaac, & Svoray, 2017). This is reinforced by the literature above, where the New Zealand Government had to create a new organisation and an Act to adjust for the Canterbury Earthquake series. Vatenmacher et al. later stated that there is a clear lack of study regarding the amount of information or data that an organisation can collect to quantify the actual needs for an effective preparedness plan. Information management also applies to during and after disaster management. “It is often desirable to deliver such status information as soon as it becomes available.” Li et al. (2017) posed the question of how to effectively capture information from diverse sources and implies that information management during and after disasters needs to be in simple reports and delivered in a timelier fashion compared to normal business scenarios.

Information flow is how a medium can have influence on another medium within a system (Lowe, 2004). This is a very broad term that encompasses the whole definition of what information flow can be. As for the information flow during the Canterbury earthquakes, it was stated that the importance of information flow during the rebuild was mainly between interest or stakeholder groups (Vallance, 2015). Vallance noted that the communication link between groups, ultimately the information flow between them, was successful for large scale recovery stages. One of the lessons professed in a report by the Greater Christchurch Group and the Department of the Prime Minister and Cabinet was to set up pre-arranged service agreements to provide systems and processes across the core corporate services, including information services and technology. Here they are preluding to the requirements and need for systems that are already in place prior to disasters.

### *4.3 Disaster management*

Disaster management is the process of dealing with natural events. These events can be simple everyday things such as popping a tire to extreme, catastrophic events (Disaster management: Enabling Resilience, 2015). The level of preparation for such events varies depending on the rarity

and the severity of the events. Disaster management: Enabling Resilience states that disaster management is made up of resilience engineering and management as a control. The importance of resilience engineering is how we are prepared for such disaster. Preparedness can be linked to pre-disaster and post-disaster plans and the ability to learn from past disasters. Another definition of disaster management is how it involves the main stages of disaster, mitigation, risk reduction, prevention, preparedness, response and recovery (Dorasamy, Raman, & Kaliannan, 2013). Dorasmay et al. states that the importance of disaster management over the last decade is due to the large increase in deaths due to natural disasters.

After the Canterbury earthquake series, disaster management in New Zealand was in the spotlight (Critical Success Factors for Post-disaster Infrastructure Recovery, 2016). As explained earlier in this report, these are the post-disaster decisions made by the New Zealand government and local government. These decisions can be considered the disaster management of the bodies listed. The Critical Success Factors for Post-Disaster Infrastructure Recovery report reviewed the decision-making process and ultimately the disaster management system in New Zealand using a series of critical success factors. One of these critical success factors is the standardisation of the "data management mechanism." The report suggested that the stakeholders that were responsible for large data and information management believed it was handled appropriately. However, the review showed that there was a lack of an integrated information documentation mechanism such that inconsistent format and incomplete data can be found in the databases; and there was incompatibility and inconsistency of different data sources due to a variation of data management systems deployed by different users. Dorasamy et al. (2013) suggested points of consideration to make when creating a knowledge management system for disaster management. These are summarised as:

- Catering for the need of diverse stakeholders impacted beyond the disaster situation

- Support both information and knowledge requirements of different roles played by the actors (emergency responders and planners). Allow them to share both tacit and explicit knowledge
- Handle timely coordination efforts through both synchronous and asynchronous feedback, during the different phases of a disaster situation.

Looking at the capacity and capability of recovery and rebuild in Christchurch, for instance, a lack of understanding of resource availability does more harm than a lack of human resources and capacities for post-earthquake recovery (Chang-Richards et al., 2014, 2017). It is crucial for the decision makers and agencies to know what sorts of expertise needed for effective post-disaster recovery and rebuild and where such capacity and networks exist nationwide and internationally.

## 5. Research methodology

This section explains the procedures of data collection and data analysis of the study. The methodology adopted for the study is a case study approach using two disaster environments of recent history as a basis for data collection. The study included human participation and so an ethics approval was required prior to interviews, survey and workshop/focus groups being conducted. This was to ensure confidentiality and protect interests of the participating individuals/organisations. Ethics approval was approved by the University of Auckland Human Participants Ethics Committee on the 10th June 2016 for three years (Ref No. 017475).

### *5.1 Case study*

A case study method was applied for this research due to its theory building nature (Eisenhart, 1989). According to Yin (2003), the case study design provides an empirical investigation of a comntemporary phenomenon within its own context. In this research, a case study approach allowed for understanding multiple perspectives from relevant professionals who have had experience in a

disaster environment. The study and the field trips took place while both Christchurch and Kaikōura were recovering from the earthquakes, which enabled the researchers to capture first hand data about resource sharing and mobilisation between two recovery practices and validate the findings.

The selection of Canterbury earthquakes and Kaikōura earthquake as two case studies are based on such criteria:

- Type of events: The same type of earthquake disaster in two cases made it possible to compare whether, or not the resources and expertise involved in the Canterbury earthquake recovery have been effectively mobilised to contribute to the recovery from the Kaikōura event.
- Timing of events: As alluded to earlier, the Kaikōura earthquake took place in November 2016, by which time the recovery of critical horizontal infrastructure and residential properties was near completion in Christchurch. Therefore, it allowed us to examine to what extent the key actors were able to utilise information and knowledge (or lessons learned) from Chriscthruch recovery experience in the case of Kaikōura recovery.
- Access to data: The lead researcher have had exisiting connections with representatives from key decision making agencies, including the Canterbury Earthquake Recovery Authority (CERA), Ministry of Business, Innovation and Employment (MBIE), Stronger Christchurch Infrastructure Rebuild Team (SCIRT), Northern Canterbury Transport Infrastructure Recovery (NCTIR), The Treasury and Christchurch City Council (CCC). Data collection from relevant professionals involved in earthquake recovery in both Christchurch and Kaikōura was facilitated by these agencies.

In addition, although the events of Christchurch occurred seven years ago, plentiful resources and remaining professional knowledge still exist, particularly in the greater Christchurch area. This makes the events a plausible case study to use when considering the potential of an expertise

database. The Kaikōura earthquake came with unique response and recovery challenges which provided another excellent case study to utilise. With large ongoing recovery efforts and diminishing days until the next disaster, lessons from these two case studies could greatly assist in future recovery efforts.

### *5.2 Data collection methods*

Data collections adopted a triangulation approach that combines quantitative and qualitative methods (Jick, 1979). The qualitative method involved conducting interviews with selected industry professionals and personnel who were involved in the events of the Canterbury and Kaikōura earthquakes, specifically the post disaster recovery environment. In total, 24 interviews with 25 personnel of varying roles pertaining to the earthquake recovery were organised and undertaken in a field trip in July 2018 at various locations in Christchurch and Kaikōura (See Table 1).

**Table 1: Basic profiles of interviewees**

| Interview No. | Participant organisation | Role | Code |
|---|---|---|---|
| 1 | Concrete New Zealand | Manager | CNZ 1 |
| 2 | Community member | Community advocate | CM 1 |
| 3 | Naylor Love Construction | Manager | N1 |
| 4 | Regenerate Christchurch | Project manager | RC1 |
| 5 | Resilient Organsiations | Researcher | RO1 |
| 6 | Statistics New Zealand | Analyst | SNZ |
| 7 | Quake Centre | Manager | QC1 |
| 8 | McConnell Dowell | Site manager | MD1 |
| 9 | Downer | Previously SCIRT Delivery Team Leader | D1 |
| 10 | Fulton Hogan | Previously Christchurch City Council asset manager, being part of SCIRT | FH1 |
| 11 | Department of Prime Minister and Cabinet | Representative on SCIRT board | DPMC1 |
| 12 | Treasury | Previously involved in CERA | T1 |
| 13 | Brian Perry Civil | Project manager | BPC1 |
| 14 | BECA | • Engineer<br>• Project manager<br>(both seconded to SCIRT project) | B1<br>B2 |
| 15 | Fulton Hogan | Operations manager for Canterbury rebuild | FH2 |
| 16 | Kaikōura District Council | Project manager | KDC1 |
| 17 | Aurecon | Engineer, a designer at SCIRT | A1 |
| 18 | NCTIR | Previously involved in SCIRT | N1 |
| 19 | NCTIR | Operational delivery | N2 |
| 20 | NCTIR | Project manager | N3 |
| 21 | Kaikōura District Council | Civil Defence professional | KDC2 |
| 22 | NCTIR | Designer | N4 |
| 23 | NCTIR | Construction manager | N5 |
| 24 | NCTIR | Communication/information management | B6 |

Interviews sought to collect data in answering the research questions set out for this research project and an additional open question was asked about participants' opinions on how expertise mobilisation can be improved for future disaster response and recovery in New Zealand. During the field trip, two focus groups were also organised with relevant expertise at Christchurch City Council and Kaikōura District Council. Participants in focus groups were professionals different from those interviewed (See Table 2). The focus of focus group was on discussion of the effects of relevant decisions in relation to resource and expertise mobilisation on earthquake recovery.

**Table 2: Participants in the focus groups**

| Date | Organisation | No. of participants | Role |
|---|---|---|---|
| 4th July 2018 | Christchurch City Council | 7 | Those who had/have involved in Christchurch recovery from 2010/11 events |
| 10th July 2018 | Kaikōura District Council | 6 | Thosw who have been involved in earthquake response and recovery in Kaikōura |

In both interviews and focus groups, the following questions were also asked:

- How relevant experts and skilled people who reside in New Zealand was mobilised, or not?
- Who were the actors and what were the logistics associated with their engagement? And
- To what extent the key actors were able to utilise information, expertise and knowledge in a systematic way?
- What was your involvement in the recovery of the Christchurch earthquake events/Kaikōura earthquake?
- How soon were you mobilised to respond, and do you think this was efficient?
- Would your efforts in the recovery process been greater or jobs easier if you or other expertise were mobilised quicker?
- How do you think a mobilisation protocol or database would aid in the recovery process, do you think it would help in circumstances similar to the ones faced?

By aggregating the data from interviews and focus groups, we were able to identify the key capability issues, actors and logistics associated with expertise mobilisation for response and recovery from two case study events. A consistent pattern emerged from qualitative data was that the majority of participants considered 'word of mouths' and 'decision makers' own network' (e.g. *"it depends on who you know"* – quote from FH1 and N1) were the primary mechanisms used in both Christchurch and Kaikōura in terms of identifying and mobilising relevant expertise in the country. A notion in

common was that although Kaokoura recovery might benefit from having a number of exisiting trained staff and skills with earthquake recovery experience in Christchurch, such a number was smaller than one would have expected. There is a need for a nationwide expertise information system for decision makers to draw upon, so that the expertise can be identified and utilised in a transparent and effient manner. To understand from industry prefessionals' own perspective of how this could happen, a simple questionnaire survey was designed and distributed between August and September 2018 to a sample of 80 engineering and construction professionals operating in Christchurch and Kaikōura.

The questions in the survey were aimed to collect information on 1) the types of web-based profiles used by the survey participants; 2) Whether or not the participant have a LinkedIn profile? And how often it was updated; and 3) For future disaster response, how can people who want to utilise the participant's expertise or need his/her professional advice locate them if the participant changes occupation, employer or contact details. As of end of September 2018, out of 80 targeted number, 27 people responded to the survey, with a response rate of approximately 34%.

### *5.3 Data analysis and validation*

The qualitative data obtained from interviews and focus group discussions were recorded through the researchers notes, transcribed and further analysed using NVivo 9 qualitative data analysis software. NVivo 9 comparison query enables the comparison of data across informants and measures the degree of agreement. Further comparison of qualitative data between two case provided insight into the general trends and opinions on how knowledge can be better managed and expertise be better mobilised post-disaster in anticipation for a future event. Quantitative data gathered through the questionnaire was analysed by using descriptive analysis of SPSS.

The research results were presented at a concensus workshop in Christchurch on 24th October 2018. In particular, the architectural protocol for expertise mobilisation in response to future disasters was discussed and evaludated empirically in the workshop in which particioants were asked to comment on the practicality and relevance of research findings. The seven participants (See Table 3) agreed on the research findings will raise the awareness of the need for a self-sustained information system – a system about expertise, the human capital for disaster recovery. In what follows, the results were presented in the form of a synthesis of quantitative and qualitive data.

**Table 3: Participants in the consensus workshop**

| Date | No. of participants (Code) | Affiliated organisation |
|---|---|---|
| 24th October 2018 | 1 (CC1) | Construction company (contractor) |
| | 2 (N6&N7) | NCTIR |
| | 1 (EC1) | Engineering consultancy |
| | 3 (CCC1-3) | Christchurch City Council |

## 6. Results

### *6.1 Study participants*

As shown in Figure 1, the sampled interviewees were largely from organsiations representing a construction firm (27%), recovery organisation (23%, such as SCIRT and NCTIR), engineering consultancy (18%), or a government agency (18%). Similarly, the organsiations of those 27 people who completed the questionnaire survey fall into these four categories. Evaluating the demographic information of those interviewed and surveyed shows a more balanced picture of the types of organisations that were present in the recovery process of both earthquake events.

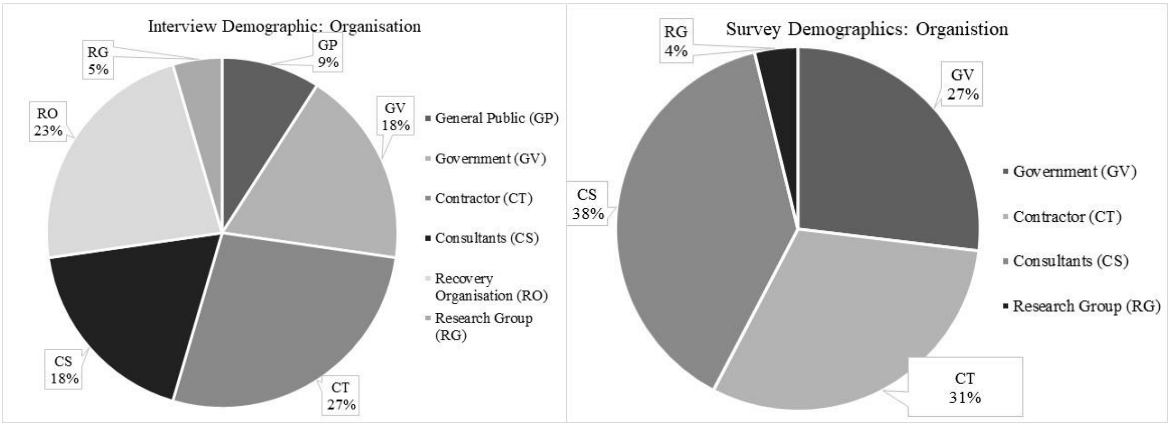


**Figure 1: Types of organisations with which study participants were affiliated**

### *6.2 Common issues about expertise mobilisation*

6.2.1 Expertise mobilisation mechanisms

There was a common notion from the interviews that in spite of New Zeland being a hazard-prone country, when responding to the Canterbury earthquake events, expertise mobilisation was more focused on technical aspects of building solutions, rather than recovery solutions with community recovery being considered as a whole. A large number of engineers, in particular, were swiftly engaged by the Institution of Professional Engineers New Zealand (IPENZ, the NZ's professional body for engineers, now is called Engineering New Zealand) in the building evaluation process. In addition, professional institutions, universities and building regulatory agencies assembled in workshops and seminars to discuss solutions for damage assessment and safety evalution of damaged buildings.

Decision makers, however, had little contact with those people who possess expertise and knowledge in post-disaster response and planning for recovery. According to interviewees CM 1 and T1, the consultation with NZ 'local expertise' in earthquake recovery was limited, partially due to a lack knowledge of the expertise that exisit in the country. The interviewee RO1 further added that research

communities in disaster risk reduction were gathered in workshops to share recovery lessons learned from previous events in other countries; it was yet unknown how much their opinions were received by decision making agencies. What is known is that a team of policy makers visited their counterparts in Victoria, Australia in a reconnsisnace trip to learn how they established the Victorian Bushfire Reconstruction and Recovery Authority (VBRRA) to coordinate reconstruction from the Febuary 2009 'Black Saturday' bushfires. These learnings directly resulted in the birth of a new government department: the Canterbury Earthquake Recovery Authority (CERA) to coordinate earthquake recovery activities in Christchurch. Roger Sutton, previously chief executive of a regional electricity distribution company, was appointed to head the authority. The early establishment of the CERA and appointment of its head had instilled a sense of certainty for recovery, but this advantage would have been lost if staffing requirements were not quickly satisfied. The staff members comprised the initial start-up team were largely sourced or seconded from New Zealand Government departments and business organisations.

Another critical initiative adopted by CERA was a coordinated approach to monitoring resource demand from all the rebuild sectors (i.e. residential, infrastructure and commercial buildings). There was a designated Resource Manager in CERA who assumed responsibilities of working with various PMOs to map the exisiting and projected demands of human and material resurces and share such information with all recovery participant organisations. Findings from interviews and focus groups suggested that most engineering and construction companies had relied on four mechanisms to identify and resource relevant expertise to fill certain professional roles, namely: word of mouth, using Linkedin for 'head hunt' recruitment, using professional network such as IPENZ and other web-based profiles (Figure 2).

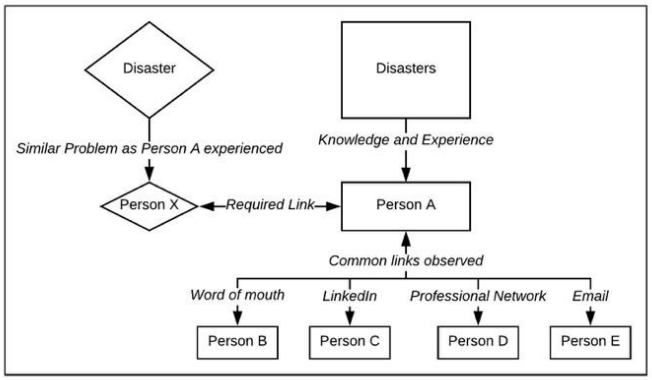


**Figure 2: Mechanisms used for expertise mobilisation for earthquake rebuild**

Interviews with those who were involved in SCIRT delivery in Christchurch and, as the time of interview, worked for NCTIR (N2-N6), however, painted a different picture of expertise mobilisation mechanisms used in infrastructure recovery from both events. According to interviewees N4 and N6, resource mobilisation channels for establishement of SCIRT and NCTIR and their ongoing operations, heavily depend on the partnerships that were already in existence prior to the earthquakes. These partnerships had proved useful for obtaining crucial information during the response and recovery phases of the events. Several inter-organisational relationships that came to the fore during the event existed between national-level organisations, and others were enacted regionally and locally, including, such as

- There were existing partnerships between the Minsitry of Transport (MoT), New Zealand Transport Agency (NZTA), and other government agencies for security and emergency management purposes
- Existing partnerships of the Ministry of Civil Defence and Emergency Management (MCDEM) and Regional Civil Defence and Emergency Management (CDEM) groups with the NZ Transport Agency and KiwiRail
- Intra-organisational relationships between shipping companies, freight and trucking companies, NZ Police, regulators, and sector representative bodies

- The South Island Regional Transport Committee (SIRTC) which was established in 2016 prior to the Kaikōura earthquake composed of representatives from South Island Regional Transport Committees (RTCs). SITRC was to provide oversight on transport decisions and outcomes that could affect the South Island
- Existing relationships between delivery contractors who were part of alliance SCIRT/NCTIR and infrastructure owners

Compared to that was in Christchurch, expertise mobilisation for infrastructure recovery in Kaikōura was more efficient and enhanced through NCTIR, which was assisted by lessons and staff transitions from SCIRT, established following the Canterbury 2010/11 earthquakes. Interviewees N2-N5 in Kaikōura also highlighted the importance of re-exisiting relationships between NZTA and KiwiRail (and their contractors) which facilitated the information about each other's transport network to be readily shared and transferred.

### 6.2.2 Expertise capacity and capability constraints

Although a lot of people moved into the Canterbury and Kaikōura regions, yet many interviewees reported the lack of labour and experienced professionals in several roles (See Figure 3, the findings were consistent with Chang-Richards et al., 2017). The most-needed expertise included structural engineers and geotechnical engineers, followed by project managers, quantity surveyors and general decision making professionals. A lack of construction expertise was more an issue in the Canterbury earthquake series rather than the Kaikōura earthquakes, where the Canterbury earthquake had the labour force but a lot of staff lacked the required qualifications. The shoartage of board level staff and experienced professionals in project management was largely due to burnout issues and a higher turnover rate in a highly stressful work environment during the recovery stage. This issue was made

worse by the observation that at the final stage of recovery in Christchurch, a lot of engineering professionals that moved to the region were at a graduate level.

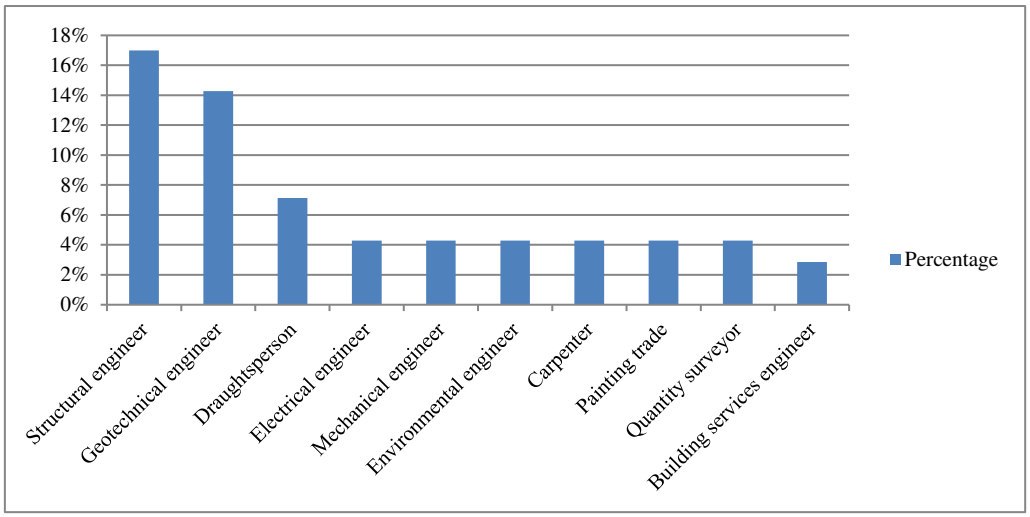


**Figure 3: Top 10 construction skills with capacity shortages as of 2014** (Source: Chang-Richards et al., 2017)

Many of the people interviewed were impressed with the speed of their personal mobilisation. While some pointed that the quick response of SCIRT and NCTIR played a significant role in their personal mobilisation. Another common theme from the interviews was the movement of people to the region of the disaster. Several interviewees quoted numbers that their organisations doubled in staff post disaster, mainly in the engineering and construction businesses. Others mentioned the North Island based businesses moved into the Canterbury region for the first time immediately following the 22 Feburary 2011 earthquake in Christchurch, several of which are still operating. When asked about how the construction and engineering businesses coped with increased reconstruction demand, the majority noted that a lot of new staff came from overseas in particular Europe and Australia, while the level of these staff ranged from project managers to graduate level engineers. Findings from interviews are consistent with what was discovered in a previous study, looking at the effects of Canterbury earthquakes on resource shortages in the construction sector (Chang-Richards et al.,

2017). The skills and expertise needed for different stages of recovery varied with a large number of interviewees commenting on the difference in skill sets between New Zealand engineers and those that came from abroad.

For the context of this research it was important to understand what attracted these extra expertise to the region. The most shared opinions were people's general desire to help, to grow their personal career which relates to the number of graduate level professionals and those people that were attracted to the high stress and demand environment of disaster management work. The last comments made on the mobilisation of people were the turnover rates, the most interesting and common response was that project managers and board level staff had the highest turnover rate. While the turnover rate was perceived as only slightly higher than business as usual, the main reasons observed for leaving were the stressful environment and the repetitive nature of the work.

### 6.2.3 Making '***connections***' before '***mobilisation***'

When asked about to what extent the key actors were able to utilise information, expertise and knowledge from Christchurch recovery in support of the recovery of Kaikōura, the opinions of interviewees seemed to be split. Nearly half of the interviewees noted that many of the personnel involved with the Christchurch recovery moved on to the Kaikōura recovery in 2016, while the other half raised that the mobilisation of skilled people of earthquake recovery experience was not as direct as one would have thought. In particular, in the concensus workshop participant N6 pointed that among the five SCIRT delivery teams (City Care, Downer Construction, Fletcher Construction, Fulton Hogan and McConnell Dowell) for Christchurch rebuild, only two (Fulton Hogan and Downer) were chosen to be part of NCTIR alliance in Kaikōura and this questioned the decision making for selecting the two new contractors (HEB Construction and Higgins) that formed NCTIR.

Interviews and two focus groups highlighted the capability challenges faced by decision makers and participanting organisations in earthquake recovery. However, several interviewees (CNZ1, N1-2, QC1, KDC1) raised that the ability to 'know-who', namely the types of expertise that reside in the country or internationally, should be considered as a critical capability in disaster recovery decision making. This comment, however, provided a fresh perspective about capacity issues faced by the two case studied events. It was noted in the interviews that while necessary expertise information were not always easy for organisations to obtain, and if obtained, were not always available in a timely manner. This is not surprising the 'word of mouth' appeared to be the most effective way of identifying and locating expertise in response and recovery from both earthquakes.

Most interviewees suggested limitations that prevented or hindered access to information and data. Barriers to locating and further engaging the 'right people' were often caused by a lack of knowledge of 'who' to contact in times of crisis. Several focus group participants noted possible issues with the decisions currently being made for expertise mobilisation in both Christchurch and Kaikōura. Participants raised concerns about whether the 'tap the shoulder' approach and 'word of mouth' mechanism are adequate to make the best use of expertise and skills that are available in the country. The interviewee N5 commented that the lack of 'know who' seemed to be problametic in the initial response to the Canterbury earthquakes and using exisiting connections may mean that some best expertise might have been missed out in the recovery process. To develop and coordinate effective responses to future disaster events, decision makers needed to rapidly obtain as much information as possible. The majority of study participants suggested that an expertise profile information system powered by exisiting skills and career profiling webs might offer a solution.

From the results in questionnaire survey, LinkedIn had become a potential option for a database as a large amount of people had endorsed the potential of it (Figure 4). Out of 27 respondents, the majority

(85%) have a LinkedIn profile which is regularly updated by users. A few interviewees mentioned that they did not have LinkedIn but could see it being a good idea to identify relevant expertise that reside in the country.

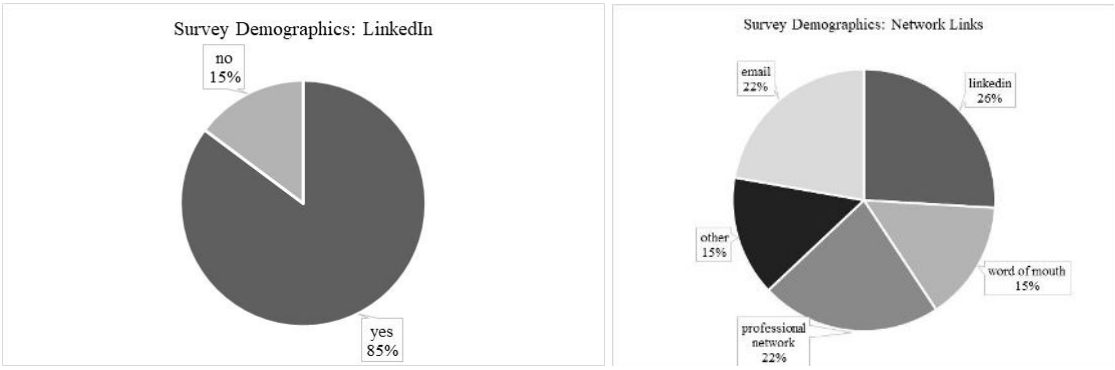


**Figure 4: Questionnaire results**

Those surveyed were also asked how people can track them down if their contact details have changed, as shown in Figure 4, 70% of the respondents said by personal email, LinkedIn or professional network, and a further 15% stating ‘word of mouth’.

### *6.3 A protocol of databse for expertise identification and connection*

An architectural protocol of a database of expertise utilising the Linkedin and web-based personal career and profession profiling is provided in Figure 5. The database can be used by decision makers and any organsiations who are/will be involved in disaster response and recovery as a tool to quickly identify and locate relevant expertise needed. The database, if well maintained by professional bodies, can also be used to measure the capability and capacity in New Zealand for future disaster reconstruction. In the event of another disaster, while unique in nature, a region could suffer from the similar issues such as water network damage. In this case, it is possible for the person or team responsible for managing its repairs to make contact with someone in this database who possess experience and knowledge on the matter. The database would therefore need to accommodate at least

three of the four common mechanisms observed in the research, namely s word of mouth, LinkedIn, professional network or person's personal email.

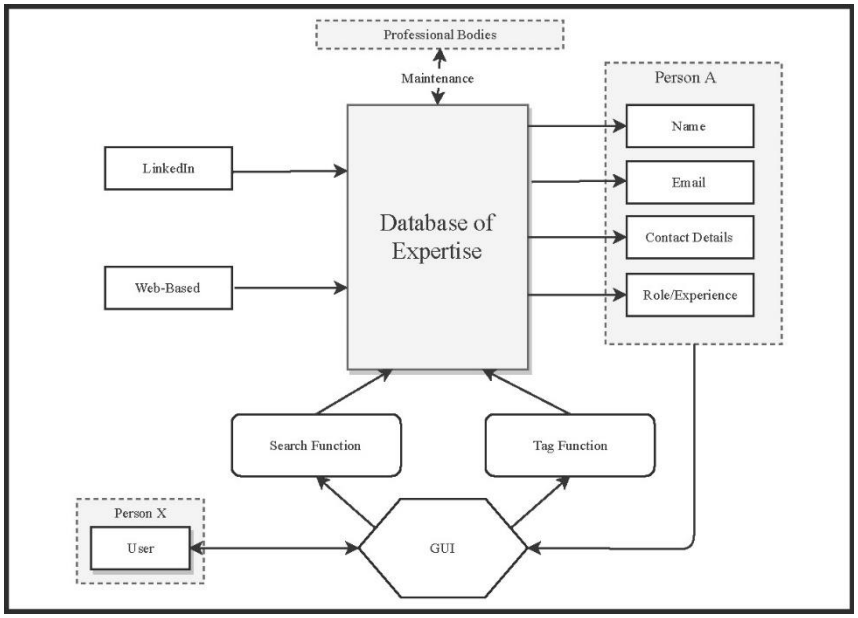


**Figure 5: An architectural protocol for expertise identification and mobilsiation**

As shown in Figure 5, the database is designed for Person X to use the graphical user interface (GUI) to find Person A with the relevant skills and expertise using either simple tags or a keyword search function. The basis of the database can be a LinkedIn network page, where the database will search through the participants or a web based system which is manually loaded with professional's details. The maintenance of the database can be left to professional bodies or government. This could include organisations such as Engineering New Zealand (previously IPENZ), central government and local government such as councils.

The following charasteristics of the database were suggested by participants in the final consensus workshop:

- The database will need to utilise a base system which can be either LinkedIn or a web based system.

- The database will need to be maintained and managed, this can be completed by a professional body, or a central government agency.
- The database will should be designed to be user friendly via a well construction graphical user interface.
- From the qualitative data there was strong support in regards to the usefulness of such a database as an information system that can enhance the decision makers's 'know-who' capability to effectively identify and mobilise expertise needed for disaster recovery.

## 7. Recommendations

Based on the findings outlined in the previous sections, a number of ways can be considered by key actors in this research to enhance New Zealand's capacity and capability in responding to large disasters. Practices that can be developed prior to future shock and stress events are suggested below:

- Specific to New Zealand context, as 'word of mouth' appeared to be the most commonly used approach for identifying and reaching people of required skills, relationship development work (at personal, organisational, intra-oagnisational and inter-organisational levels) should continue.
- As part of developing both regional and national capability for disaster recovery, a robust data system is important, and should align with the self-sustained personnel career profiling webs that are in place. We suggest that Linkedin be utilised for this purpose. Data platform options should be explored to host and deliver such information.
- New technologies should be considered such as the potential for a registry system where people can indicate their availability and interest in certain roles in a disaster recovery situation. Much of this data is gathered from industry associations/professional bodies and

can be utilised and passed on to appropriate decision making organisations. This would assist with post-disaster recovery plans such as the prioritisation of recovery activities depending on the availability of relevant expertise.

- Apart from 'know-who', stakeholders, particularly key decision-makers, should consider improving 'know-how' capacities in advance of the next crisis. For example, engineering organisations should develop expertise in earthquake design and land liquefaction and construction companies should have a plan to cope with complex demands in disaster recovery and address the ability to run operations from multiple locations nationwide.
- Future disaster response and recovery strategies should also consider how to document recovery lessons and retain expertise where possible. For example, lessons learned by key actors in terms of physical infrastructure recovery that they experienced following the Canterbury earthquakes and Kaikōura earthquake.
- Finally, a more thorough review of how well the central government, local government and recovery organisations assess the demand of recovery and supply of expertise could be conducted. This will reduce the effects of demand fluctuations on organisational capability development.

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**Endnote**

[i] Horizontal infrastructure includes roads, storm water systems, fresh water supply systems and waste water disposal systems.