Assessing social resilience to disasters at the neighbourhood level:

Co-producing a resilience assessment framework

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Abstract

Disasters of the past decade have drawn considerable attention to the need to build resilient communities and prompted the adoption of disaster resilience policies across communities, cities, and nations. As policies are translated into local actions, policymakers, researchers, and practitioners are advocating for the measurement of disaster resilience as a means to identify areas for improvement, plan interventions, evaluate the effectiveness of resilience strategies, and monitor resilience progress.

The need to assess disaster resilience has spawned a growing body of research examining the underlying drivers of resilience and identifying how disaster resilience can be operationalised and measured. In particular, recent research has focused on the importance of social resilience, which is a component of disaster resilience and refers to the capacity of people and communities to deal with external stresses and shocks, and how it contributes to disaster preparedness, disaster response, and post-disaster recovery. However, while local communities are seen as the frontline in preparing for and responding to disasters, the scale of analysis for much of the existing resilience assessments have focused on the city or higher levels of analysis. Questions thus remain about whether these assessment tools are relevant and applicable at the sub-city or neighbourhood level.

This thesis seeks to develop social resilience assessment measures for neighbourhoods through integrating scientific and local knowledge. Using an appreciative inquiry approach, a workshop with hazard researchers, practitioners, and a policymaker in Wellington, New Zealand, was first conducted in 2015. This was followed in 2016 by a series of focus groups with stakeholders in five neighbourhoods across the Wellington region in New Zealand, and the City and County of San Francisco in the United States. The workshop and focus groups explored how social resilience is conceptualised, its essential characteristics, and neighbourhood-specific contextual influences that shape social resilience levels.

Responses from various stakeholder groups – hazard researcher, emergency practitioner, policymaker, and neighbourhood stakeholder – revealed similarities in how social resilience is perceived. Social resilience is conceptualised as having both cognitive and structural dimensions and is linked to communities' economic, infrastructural/built, natural, and institutional/governance environments. Cognitive characteristics – those that relate to people's attitudes, values, and beliefs as well as their mental processes and perceptions of themselves and their environment – include collective efficacy, sense of community and place attachment, decision-making inclusiveness, and unifying leadership at the neighbourhood-level. Structural dimensions relate to discrete features and

characteristics of people and communities and include their diversity of skills, education and training; social networks; access to financial resources; and understanding potential hazard risks and impacts. These characteristics form a framework for measuring neighbourhood-level social resilience.

Furthermore, these shared characteristics across different stakeholder groups demonstrate the potential universality of social resilience assessment constructs at the neighbourhood level that could inform new models for measuring disaster resilience. They also provide a foundation for local-level stakeholders (e.g., policymakers, practitioners, and community members) who are looking into baselining neighbourhood disaster resilience using an integrated approach.

While different stakeholder perspectives contain similarities, this thesis finds that common social resilience characteristics are contextual to individual neighbourhoods, reflecting diversity at this level of analysis. By examining the concept of social capital – one of the social resilience characteristics – three key themes were identified that influence the formation, activation, and benefits of social capital resources: community demography, cultural influences on social support, and neighbourhood governance. An assessment framework was proposed that incorporates both quantitative indicators and contextual questions across six structural dimensions (i.e., population stability, neighbourhood-based organisations and groups, coordination between community-based organisations, linkages to cultural and ethnic minority communities, presence and effectiveness of neighbourhood leaders and community-based organisations, and inclusive and transparent government processes) and four cognitive dimensions (i.e., cultural beliefs and expectations, trust, social support, and empowerment through collective action).

Thus, the results of this thesis highlight one important consideration in the development and implementation of resilience assessment tools at this geographic scale. While this research points to potential universality of social resilience assessment constructs and measures, it has also identified the need to consider contextual influences and characteristics when mapping them onto various neighbourhoods.

Acknowledgements

On a beautiful day at San Francisco Union Square in 2014, my primary PhD supervisor David, his family (Carol and Joshua), and I had coffee and talked about my enrolling in a PhD programme in Wellington, New Zealand. Four years after that conversation, I am submitting a PhD thesis.

The last few years have felt like an endurance race. As a former marathon runner and a triathlete, I realised that 'doing' a PhD is very much akin to participating in an Ironman triathlon race, which consists of a 3.86km swim, a 180.25km bicycle ride, and a run that is 42.16 km long – all to be completed in under 17 hours. I view my PhD journey as engaging in three different activities. My first year in the PhD programme was like swimming, something I enjoy but am terribly slow at. The second year was all about gathering and writing up the research data, similar to that of a bike ride along flat roads and over mountains – sometimes it was easy, but most of the time it was uphill work. The last two years were like a marathon in which I could barely keep my legs moving. Often times, I kept thinking to myself, "How much longer do I have to go before I cross the finish line?"

Fortunately, many people were rooting for me during my journey toward the finish line. I would like to thank my supervisors, David Johnston, Emma Doyle, Julia Becker, and Douglas Paton, for their tremendous support throughout the entire process. I could not have asked for a more supportive team. To all of you: Thank you for your expertise, honest feedback, and never-ending encouragement. Even though we will be located in different countries, I suspect we will collaborate on future projects.

Another group of people who cheered me throughout this journey was the Joint Centre for Disaster Research (JCDR) team, which became my second family in many ways. To my JCDR family: Thank you for all the conversations, potlucks, morning coffees, presentations, and outings that kept my curious mind busy. I could not have asked for a more nourishing environment for my PhD studies.

To compete in a long-distance triathlon race, it requires significant amount of preparation time and financial resources. Doing a PhD is no different – it costs both time and money. I could not have completed this programme without the generous financial support from GNS Science and Massey University's College of Humanities and Social Sciences. The financial support that I received from these institutions have made my PhD journey possible and less stressful.

Furthermore, since this PhD research is about the people who have dedicated themselves to improving their communities and their disaster resilience, I would like to give a heartfelt thanks to the following people and groups:

To Dan Neely and his community resilience team at the Wellington Region Emergency Management Office, thanks to all of you for letting me be part of your community resilience-building efforts. I also would like to sincerely thank all the participants who contributed to this research and for sharing your thoughts and experiences. My appreciation also goes out to organisations that assisted in helping me recruit participants for my research, including the Wellington Region Emergency Management Office, Salvation Army – Cannons Creek (Porirua), and in San Francisco, BMAGIC, Bayview Senior Services, CYC, Self-Help for the Elderly, Neighborhood Empowerment Network (NEN), and Neighborhood Emergency Response Team (NERT). Thanks to all of you for making our communities safe and strong.

An endurance race not only pushes one's physical limits, but also tests one's mental strength. Similarly, doing a PhD programme challenged my emotional and mental health in ways that I could have never imagined. Living in a foreign land, getting rained on and being cold most of the year, and being alone in the reading and writing process made this PhD journey an emotional roller coaster. However, there was a whole team of professionals, family and friends who had helped get me through the lowest of the low times. In particularly, thank you Mark Pope, counsellor at Massey's Student Health Services: You have singularly saved me from quitting my PhD programme and have given me the necessary life tools to deal with the ups and downs of life. If there is such thing as a 'transformational' change, you have contributed to it.

To my friends in Wellington: Thank you for all the great times we shared and for keeping my mind off my PhD work when I needed it most. Thank you for letting me pet those adorable and fluffy llamas on our bike rides, sharing jugs of beer after each exhilarating day of sailing, letting me talk about anything at the Island Bay Toastmaster sessions, running and swimming with me along and in the Oriental Bay, watching three seasons of *Downton Abbey* over potlucks, and dancing with me to some great tunes at the Botanical Garden's Summer Nights. I look forward to reconnecting with you every now and then.

To my friends in the San Francisco Bay Area: Thank you for your support while I was conducting my research, whether giving me free food or free lodging (or both!) or allowing me vent about my PhD blues and sharing inspired research moments. You know who you are and I thank you.

I also owe a deep gratitude to Sara Schwartz Kendall: You provided great advice when I was doing my graduate work many years ago, and you offered invaluable encouragement and feedback as I was writing up my dissertation. Thank you for being there for me every step of the way!

During my PhD programme, I welcomed the birth of my nephew, in which he has his own hashtag #EthanTheCheekyBaby. He did not help me in any way except by distracting me from my writing. However, he continues to encourage me to laugh and play … all the time.

I am grateful for the many people who crossed my path and cheered me on during this journey of endurance. Particularly, I am grateful for the opportunity to befriend so many wonderful and thoughtful people, and to learn from and experience life with them in beautiful Wellington (and Aotearoa), which has become my second home, my second family. Thank you.

Finally, I would like to dedicate this thesis to my mother, who continues to shine a light from above: Your presence will always be with me. Since you never had the opportunity to attend college, this PhD is for you.

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Prologue

My interest in the topic of neighbourhood resilience measurements is grounded in my professional experiences in the field of disaster management. Prior to my PhD programme, I managed the Ready Neighborhood programme, a multi-year American Red Cross disaster resilience initiative that sought to increase the disaster resilience of over 20 low-income neighbourhoods throughout the San Francisco Bay Area. Central to the initiative's approach to building neighbourhood resilience was engagement with a cross-section of stakeholders including local governments, community groups, faith-based organisations, and community leaders. I was in charge of overseeing the development of neighbourhood-based resilience plans as well as the initiative's overarching monitoring and evaluation process.

I had just completed my master's degree in geography in which I examined older adults' risk perceptions of wildfires, so I was keenly aware of the literature on social vulnerability and hazard perceptions. However, the concept of disaster resilience, which was gaining traction in the policy and funding circles in San Francisco at that time, was still new to me.

Not quite sure how to 'evaluate' disaster resilience, I surveyed the field and developed a set of key quantitative performance metrics that served to measure disaster resilience as part of the Ready Neighborhood programme evaluation process. These metrics included the number of preparedness trainings provided and the number of businesses and community-based organisations that had developed a continuity of operations plan for an emergency. In programme evaluation lingo, these metrics are a form of output (e.g., production of activities such as the number of personal preparedness trainings provided), rather than an outcome (e.g., changes in the level of performance or behaviours such as increased personal disaster preparedness).

As the American Red Cross initiative approached the end of its first year, we tallied our programme output numbers and used them as a basis for promoting our programme's success in transforming our first set of neighbourhoods into resilient communities. Yet I knew that our outputs did not necessarily equate to increased disaster resilience. My experiences in engaging with stakeholders from neighbourhoods taught me that the concept of resilience is more than having people trained to be prepared for disasters and organisations having plans to continue to operate after disasters occur. While these tangible skills and plans are essential to disaster preparedness, I had a sense that intangible capacities within organisations and communities are equally important. These capacities take the form of active coordination between community groups, durable social connections

between family members and neighbours, and a strong sense of community, among many other factors. These intangible capacities make programme evaluation difficult, especially when evaluation tools are based mostly on quantitative methods. I had to deal with questions about the most effective and expedient way to quantify these intangibles, given that our initiative was operating under a compressed timeframe and budget constraints. I asked myself many times during my career at the Red Cross: How can we measure resilient capacities? What programmes or activities could be developed to move the needle of resilience?

The community partners with whom I worked had the same questions about how resilience is measured. Since the Ready Neighborhood programme's goal is to build disaster resilience, they wanted to know how the American Red Cross defines disaster resilience. It is not uncommon to hear from our partners as our programme rolls out into each neighbourhood questions such as: Are you talking about personal preparedness? Continuity of operations planning? Neighbourhood response planning?

In neighbourhood meetings, our non-profit and government partners would express their organisational objectives and community visions for a better neighbourhood. These objectives and visions were both tangibles (e.g., materials, trainings, funds) and intangibles (e.g., better communication between community-based organisations and local government agencies, an increase in residents' feelings of hope and engagement).

More often than not, each neighbourhood that I worked with had different priorities and needs. However, given the constraints of time and human and financial resources, I had to 'standardise' programme metrics across all of these neighbourhoods. This process entailed simplifying 'resilience' down to a few measurable metrics so that internal stakeholders within the organisation could more effectively focus on key programme deliverables and collect the necessary data. This attempt was met with an equal amount of successes and challenges. On the one hand, our programme's ability to standardise our programme evaluation has allowed organisational staff to quickly and effectively demonstrate successes to funders and our partners. Many of the lessons learned from managing the Ready Neighborhoods programme were incorporated into the community resilience guide published by the American Red Cross (Herbst & Yannacci, 2013). This guide does not deal with aspects of resilience that a responding organisation has no control over, such as the built infrastructure, but rather focuses on elements that the American Red Cross can affect, such as building neighbourhood networks. On the other hand, intangible elements, such as stories told by our partners, did not get captured and evaluated at all. In hindsight, many of these stories reflect exemplars of best practices

in and essence of disaster resilience that non-profit and community-based organisations, funders, and government agencies have sought to cultivate in communities.

Through my experiences working with local stakeholders, I realised there is a need for a process to baseline neighbourhood resilience levels that captures not only factors that are easily observed, but also processes and perceptions that are harder to measure. In many ways, this thesis is part of an on-going dialogue with many people for the past eight years, from my conversations with older adults about their hazard perceptions when I was a graduate student, to informal and formal meetings with colleagues and local stakeholders across the San Francisco Bay Area during my time at the American Red Cross, and to interactions with emergency management professionals, hazards researchers and research participants in Wellington, New Zealand, and San Francisco, U.S., during my PhD programme.

This thesis, therefore, is a summation of many and varied dialogues and interactions. As readers will come to realise, measuring disaster resilience is anything but a straight-forward task. It is my hope that the assessment frameworks proposed here will serve to capture and evaluate the many important elements that contribute to a neighbourhood's increased resilience and well-being.

Chapter 1 – Introduction

1.1 Context

Disasters resulting from natural hazards stem from the interaction between people and their environment (Eiser et al., 2012). As the number of people living in urban areas continues to grow, the risk for significant human and financial losses from natural hazard events such as earthquakes, floods, wildfires and extreme weather events increases. Since 1990, 1.6 million people globally have died from disasters caused by natural hazards and economic losses related to natural hazards events have grown steadily, averaging a loss of US$200 billion annually (United Nations International Strategy for Disaster Reduction [UNISDR], 2015a). The devastation on people and communities has prompted nations to enact policies to enhance disaster resilience across all levels of a society (International Federation of Red Cross and Red Crescent Societies [IFRC], 2016). With an increasing focus by governments to strengthen disaster resilience in order to reduce disaster losses, there has been a proliferation of discourse in academia, in policy circles, and in practice about what resilience is, how it can be operationalised and enacted, and how it can be measured (Committee on Increasing National Resilience to Hazards and Disasters & Committee on Science Engineering and Public Policy [Committee on Increasing National Resilience], 2012; Cutter, Ash, & Emrich, 2014). In particular, researchers, non-governmental organisations, and governments have built a case for measuring disaster resilience as a means to prioritise disaster resilience policies, evaluate the effectiveness of resilience strategies, and monitor resilience progress (Committee on Increasing National Resilience, 2012; Gaillard & Jigyasu, 2016).

Although the development of resilience assessment tools has proliferated in recent years, there remains a knowledge gap in understanding how the concept of disaster resilience is defined and determining the most appropriate way to measure it (Berkes & Ross, 2013; Gaillard & Jigyasu, 2016). As hazard researchers point to the importance of resilience of the social environment – or social resilience – there is a gap in how it is operationalised in emergency management practices (Kwok, Doyle, Becker, Johnston, & Paton, 2016). Furthermore, as local communities are seen as the frontline in preparing for and responding to disasters, measuring their resilience by using an assessment approach that seeks to understand community members' perspectives on what resilience means to them remains a knowledge gap (Gaillard & Jigyasu, 2016; Gaillard & Mercer, 2013; Sharifi, 2016). Addressing these gaps is essential to enhancing disaster resilience at the neighbourhood level because local perceptions of hazard risks and community assets can be at odds with those interpreted by emergency management agencies (Beilin & Reid, 2015). This disconnect in

perceptions could result in government-driven interventions that are maladaptive at the local level (IFRC, 2016).

To address these gaps, this research sought to address how social resilience to disasters can be measured at the local level. To ground this research, Section 1.2 provides an overview of the hazardscapes of the research study regions – Wellington, New Zealand, and San Francisco, U.S. Sections 1.3 through 1.6 present the case for building and assessing disaster resilience within the context of policies and in practice. This chapter concludes with Section 1.7, which presents the remaining structure of this thesis.

1.2 Hazardscape background

The Wellington region, New Zealand, and the City and County of San Francisco, U.S., are both exposed to various geological, climatic, and meteorological hazards due to their respective locations along tectonic plate boundaries and in close proximity to a coast (Figure 1.1). Both regions are at risk for earthquakes, tsunamis, landslides, floods and sea-level rise (City and County of San Francisco, 2016a; Dawe, 2007; Wellington City Council, 2017). They both also experience extreme meteorological hazards: Wellington is subjected to regular windstorms and San Francisco experiences annual heat events (City and County of San Francisco, 2016a; Wellington City Council, 2017).

Earthquakes are of particular concern to both regions, which experience them as low frequency but high impact events with potentially devastating consequences. In contrast to other natural hazards, earthquakes are quick onset events with no or limited lead time. Although the Wellington and San Francisco regions experience hundreds of earthquakes each year, most of them are too small to be felt by people. However, major earthquakes in these urban regions could have adverse impact on human lives, their livelihoods, and infrastructure. Recent earthquakes around the world attest to the destructive power of earthquakes: The 2011 Christchurch earthquake killed 185 people, and in that same year, the Great East Japan earthquake resulted in 16,079 deaths and 3,499 missing persons (Hasegawa, 2013).

Because both areas in this research have the potential for earthquakes and other natural hazard risks, ensuring their communities are resilient to hazard consequences is of utmost importance for reducing human and infrastructural losses and promoting the speed and quality of post-disaster recovery.

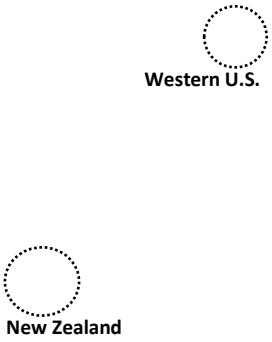


Figure 1.1 Tectonic plate boundaries around the world, with New Zealand and western United States denoted in ◌. Retrieved from https://www.gns.cri.nz/Home/Learning/Science-Topics/Earthquakes/Earthquakes-at-a-Plate-Boundary/Plate-Collision-in-NZ. Copyright (2009c) by GNS Science.

1.2.1 Geological background of earthquakes

Earthquakes occur when two blocks of earth crust suddenly slip past one another. The surface where the slip occurs is referred to as a fault or fault plane (U.S. Geological Survey, n.d.-c). Often earthquakes occur where tectonic plates meet. The arrows in Figure 1.1 represent the three types of plate boundaries: convergent, divergent and transform. Convergent boundary refers to plates that collide with each other. Divergent boundary occurs when plates move away from each other. Transform boundary is where two plates slide past each other (GNS Science, 2009d). The different types of movement along plate boundaries produce various geological formations. For instance, New Zealand's active volcanoes are a product of an oceanic plate subduction, a result of convergent plate movement, that occurs beneath the North Island and produces magma at depth (GNS Science, 2009c).

Earthquakes are measured by their magnitude or intensity. *Magnitude* is the quantitative measurement of the size of an earthquake at its source. It is based on the Richter Magnitude Scale (also known as the local magnitude (M) scale) which measures the amount of seismic energy released by an earthquake (Appendix 1) (GNS Science, 2009f). *Intensity* is the descriptive measurement of the severity of the earthquake's shaking (GNS Science, 2009f). While the magnitude of an earthquake is given as a single value, its intensity varies based on the distance from the

earthquake source and other local conditions. Thus, intensity levels of an earthquake, as expressed by the Modified Mercalli (MM) intensity scale (Appendix 2), have different values according to how people felt and what damages there were to physical infrastructure. The closer a location is to the epicentre of an earthquake, the higher its intensity. Although there are slight differences between the Modified Mercalli intensity scales used by New Zealand and the U.S., both countries adopt the scale to describe the effects of an earthquake (Appendix 3). While the magnitude of an earthquake is the measurement most often relayed to the public, scientists agree that earthquake intensity is a more meaningful indicator to non-scientists because it reflects the actual experience of an earthquake by people and the environment (GNS Science, 2009e).

1.2.2 Earthquakes in Wellington, New Zealand

New Zealand is situated along a curving boundary between the Australian and Pacific Plates that collide, or 'converge' (Figure 1.2). At the southern tip of the South Island, the Australian Plate subducts (or moves under) below the Pacific Plate. In the North Island, where the Wellington region is located, the opposite movement occurs, whereby the Pacific Plate subducts below the Australian Plate along the Hikurangi subduction zone. Throughout most of the South Island, the two plates slide against each other along the Alpine Fault (GNS Science, 2009c).

Figure 1.2 Hikurangi Subduction Zone and Alpine Fault along the Australian and Pacific plates. Reprinted from "Land-use planning for natural hazards in New Zealand: The setting, barriers, 'burning issues' and

priority actions", by B. C. Glavovic, W. S. A. Saunders, and J. Becker, 2010, *Natural Hazards, 54*(3), p. 680.

The Wellington region is located at the southwestern tip of the North Island in New Zealand. It is located near the plate boundary of the Pacific and Australian tectonic plates. This boundary is referred to as the Hikurangi subduction zone, which is where the Pacific Plate subducts the Australian Plate (GNS Science, 2013). Subduction zones are a type of fault that produces large and powerful earthquakes and tsunamis, including the 2004 Sumatra earthquake, the 2010 Chile earthquake, and the 2011 Great East Japan earthquake (GNS Science, 2009a). In New Zealand, the Hikurangi subduction zone is located along the east coast of New Zealand and extends south toward Wellington. The lower edge of the Hikurangi subduction zone sits approximately 23 kilometres from the city of Wellington in the Wellington region (GNS Science, 2013). Although large earthquakes and tsunamis can result from this subduction zone, little is known about the frequency and the magnitude or intensity of earthquakes at the subduction zone (Dawe, 2007; GNS Science, 2009a).

In addition to the Wellington region's close proximity to the Hikurangi subduction zone, it also contains several active earthquake faults (Figure 1.3). The major ones include the Wellington-Hutt Valley segment of the Wellington fault, the Ohariu south fault and the Wairarapa fault (Cousins, 2013b; Stirling et al., 2012). A rupture at the Hikurangi subduction zone, or at the Wellington, Wairarapa, or Ohariu faults is likely to cause significant material damage and loss of lives for the Wellington region (Cousins, 2013a). For instance, the Wellington-Hutt Valley segment of the Wellington fault (Map 1A) presents one of the many fault risks in the region, as it has an 11% chance of rupture (M > 7.5) within the next 100 years (Rhoades et al., 2011). The risk of rupture by one of the region's faults threatens the region's population of over 470,000 residents, many of whom live in population centres (Wellington City, Hutt Valley, Porirua, Kapiti Coast, and Wairarapa) that are within 10 kilometres of the Wellington fault (atlas.id, 2013; Dawe, 2007).

Figure 1.3 Major earthquake faults in the Wellington region (in red), Wairarapa fault not shown. Retrieved from http://data.gns.cri.nz/af/. Copyright (2015) by GNS Science.

The Wellington region is no stranger to earthquakes. Seismic features in and around the Wellington region have produced large earthquakes historically and in the recent past (Figure 1.4). The M8.2 Wairarapa earthquake in 1855 is the most powerful earthquake recorded in New Zealand. In 1942, two successive earthquakes (M7.0 and M7.2) within a two-month period in the town of Masterton in the Wairarapa region, 80 km north of Wellington city, caused severe structural damages to buildings (McSaveney, 2017). More recently in 2013, two successive earthquakes within a one-month period in Cook Strait (M6.5) and Grassmere (M6.6) resulted in minor damages to buildings in the city of Wellington (GeoNet, 2013a, 2013b; NZ Herald, 2013). In November 2016, a major earthquake measuring M7.8 struck Kaikōura in the South Island. While fortunately in that event no casualties were reported in the Wellington region, the Kaikōura earthquake resulted in significant structural damages to many of its commercial and residential buildings (McSaveney, 2017). In the Wellington region alone, up to 20 buildings have either been demolished or are earmarked for demolition, and insurance claims for property damages and loss of income from the 2016 earthquake could reach over NZ$1 billion (Winter, 2017).

Figure 1.4 Large New Zealand earthquakes in New Zealand since 1848. Retrieved from https://www.gns.cri.nz/Home/Learning/Science-Topics/Earthquakes/New-Zealand-Earthquakes/Where-were-NZs-largest-earthquakes. Copyright (2016) by GNS Science.

1.2.3 Earthquakes in San Francisco, U.S.

In the western U.S., where San Francisco is located, the North American Plate and the Pacific Plate slide past one another as part of a transform boundary. One of the most famous transform boundaries is the San Andreas fault in California, which extends from the northern part of the state to south of the U.S./Mexico boundary (Figure 1.5).

With its location along a plate boundary, the City and County of San Francisco is in proximity to a number of active faults, including the northern San Andreas, Hayward and Calaveras faults (U.S. Geological Survey, 2015b). The San Francisco region, comprising of cities and towns near the San Francisco Bay, has a history of significant earthquakes, including the Great 1906 San Francisco Earthquake (M7.7-7.9), which left over 3,000 people dead, 225,000 people homeless, 28,000 buildings destroyed, and over US$9.2 billion (2009 dollars) in property damages (Ellsworth, 1990). The devastation of the 1906 earthquake spawned a revolution of scientific earthquake research,

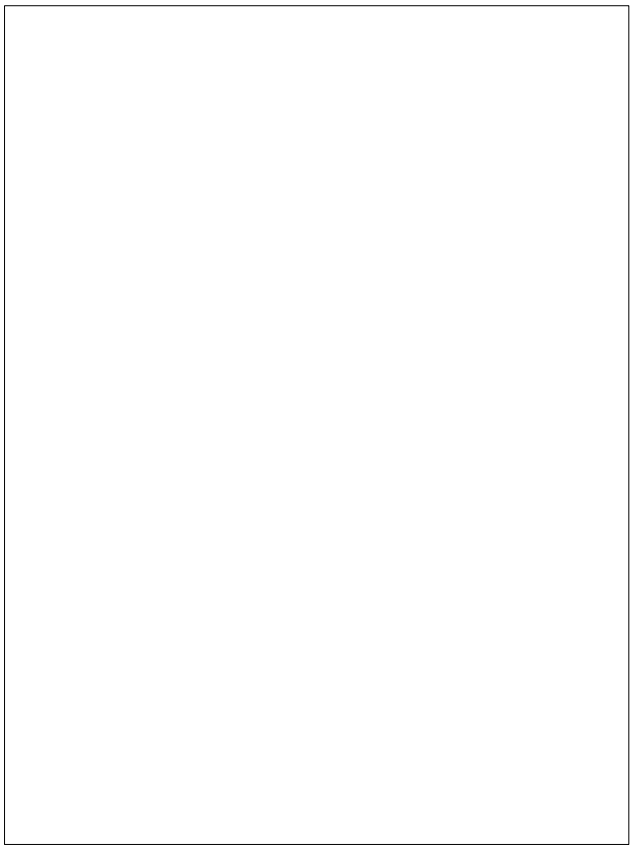


Figure 1.5 San Andreas Fault at the Pacific Plate-North American Plate boundary. Retrieved from https://earthquake.usgs.gov/learn/topics/safz-paleo/. Copyright (n.d.-a) by U.S. Geological Survey.

leading to the development of the current theory of elastic rebound, which posits that the earth's crust accumulates energy on either side of the fault during plate motion until it ruptures along the fault, releasing the stored energy that generates seismic waves and shaking (Ellsworth, 1990).

After the 1906 earthquake, the San Francisco region enjoyed a prolonged period of seismic calm for 80 years until the region was hit hard by the 1989 Loma Prieta earthquake, which was centred approximately 96 km south of the City and County of San Francisco and recorded a magnitude of M6.9 (Figure 1.6) (U.S. Geological Survey, n.d.-b). This earthquake caused the partial collapse of the San Francisco-Oakland Bay Bridge and the Cypress freeway in the neighbouring city of Oakland that resulted in the loss of 42 lives (Berkeley Seismological Laboratory, n.d.; U.S. Geological Survey, 2012). Furthermore, the Loma Prieta earthquake resulted in 13,000 housing units to become uninhabitable in the San Francisco region, 8,600 of which were within the City and County of San Francisco (Figure 1.7) (Paxton, 2004; U.S. Geological Survey, 2006).The monetary damages to housing stock, highway systems, and lifelines (e.g., gas distribution pipelines) totalled US$5.9 billion (1989 dollars).

Even more recently, the Napa Valley region, which is north of San Francisco and is famed for its wineries, experienced a large earthquake (M6.0) in 2014, the largest in the San Francisco Bay Area since the 1989 Loma Prieta earthquake. It resulted in one death, dozens of injuries, and economic losses of more than US$500 million (2014 dollars) (U.S. Geological Survey, 2015a).

Figure 1.6 Loma Prieta earthquake epicentre. Reprinted from "Progress toward a safer future since the 1989 Loma Prieta earthquake", by T. M. Brocher, R. A. Page, P. H. Stauffer, and J. W. Hendley II, 2014.

Figure 1.7 Residential building collapsed after the Loma Prieta earthquake in San Francisco. Retrieved from https://pubs.usgs.gov/dds/dds-29/web_pages/sf.html. Copyright (1999) by J. K. Nakata.

Earthquake risks for the region remain high. According to the U.S. Geological Survey from 2014, there is a 72% chance that the San Francisco Bay Area region will experience a major earthquake (M6.7+) by the year 2043, with likelihoods of 33% for the Hayward fault, 26% for the Calaveras fault, and 22% for the San Andreas fault (Figure 1.8) (Aagaard et al., 2016). Depending on the location and severity of the next major earthquake, it is predicted that 83,000 housing units in San Francisco could be lost, resulting in tens of thousands of displaced residents (Paxton, 2004).

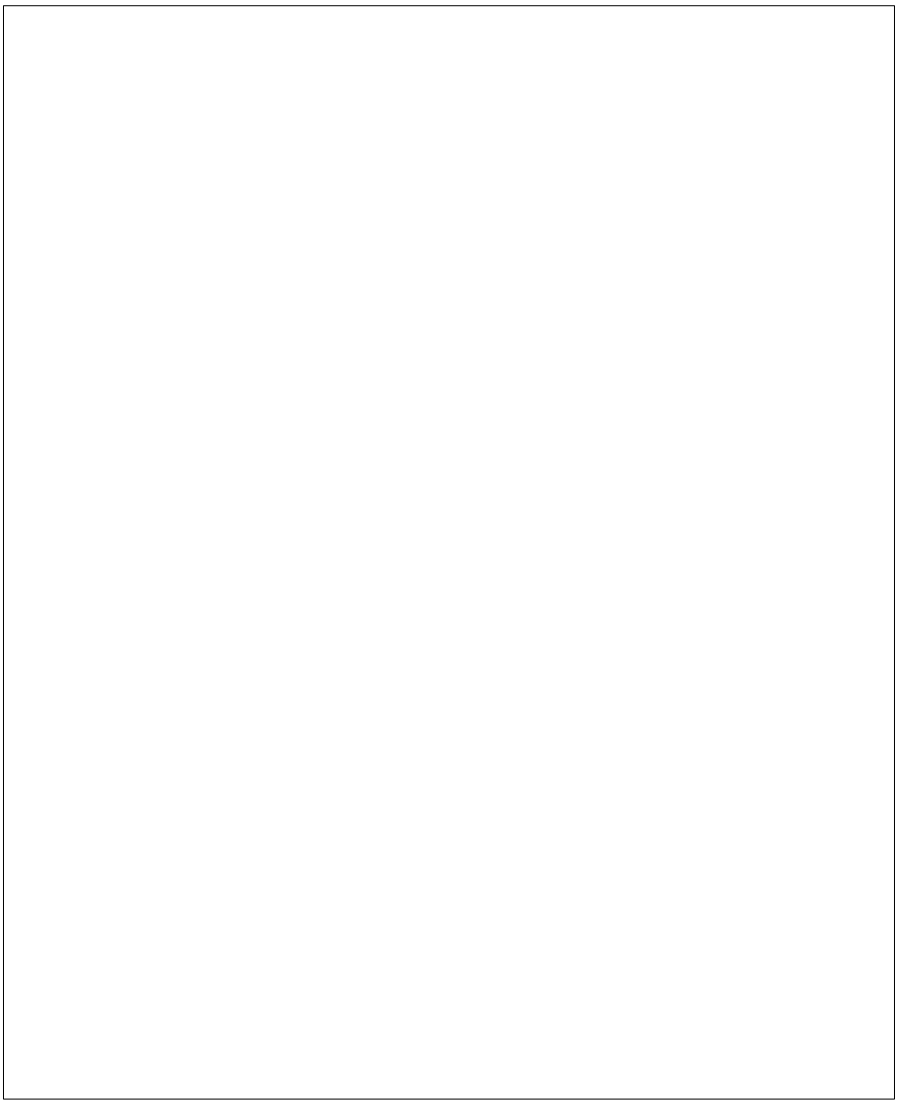


Figure 1.8 Probability of one or more M6.7 or greater earthquakes for each fault in the San Francisco Bay Area. Reprinted from "Earthquake outlook for the San Francisco Bay region 2014-2043. Fact Sheet 2016–3020", by B. T. Aagaard, J. L. Blair, J. Boatwright, S. H. Garcia, R. A. Harris, A. J. Michael, D. P. Schwartz, and J. S. DiLeo, 2016.

With the Wellington and San Francisco regions facing significant risks from earthquakes and other natural hazards, people living in these regions could face prolonged disruptions in their daily lives in the areas of housing, the local economy, and physical infrastructures such as roads and lifelines. Therefore, individuals and communities need to build resilience to disasters by anticipating and preparing for potential hazard consequences and adapting to immediate and ongoing challenges posed by a disaster.

1.3 What is disaster resilience?

Building disaster resilience is tantamount to ensuring that communities are adequately prepared for and have the capacities to effectively respond to, and recover from, potentially devastating impacts from earthquakes and other natural hazard events. Over the last 20 years, there has been a

proliferation of discourse in research, in policies, and in practice about what disaster resilience means and how to operationalise it within neighbourhoods, cities, regions, and nations.

The concept of resilience was first explored by Holling (1973) within the context of ecological systems. Since then, the term 'resilience' has been used in various research disciplines, including psychology (e.g., Tugade et al., 2004), sustainable development (e.g., Magis, 2010), climate change science (e.g., Nelson et al., 2007), and disaster research (e.g., Manyena, 2006; Paton & Johnston, 2006). Definitions of resilience are diverse and plentiful. A recent research report identified 120 distinct definitions of resilience, a majority of them from sources published since 2000 (Stevenson, Vargo, Ivory, Bowie, & Wilkinson, 2015). The most frequently used words in definitions of resilience are listed in Table 1.1.

Table 1.1 *Most frequently used words in definitions of resilience*

Word	Count	Similar Words (included in count)
ability	61	ability
adapt	47	adapt, adaptability, adaptation, adapted, adapting, adaptive, adaptively
capacity	34	capacities, capacity
recover	31	recover, recovers
event	25	event, events
disaster	22	disaster, disasters
function	21	function, functional, functionality, functioning, functions
absorb	17	absorb, absorbed
stress	16	stress, stresses
shocks	16	shock, shocked, shocks
adversity	14	adverse, adversity
process	14	process, processes
disturbance	13	disturbance, disturbances
maintain	12	maintain, maintaining
cope	12	cope, coping
impacts	12	impact, impacts
return	11	return, returns
back	10	back
respond	10	respond, responding
hazard	10	hazard, hazardous, hazards
resist	9	resist, resisting
bounce	9	bounce

Note. From "Resilience benchmarking & monitoring review", by J. R. Stevenson, J. Vargo, V. Ivory, C. Bowie, and S. Wilkinson, 2015, *Resilience to Nature's Challenges,* p. 6.

The wide-ranging interpretations of the concept are a result of the diverse epistemological and theoretical perspectives that underpin resilience research (Cutter, 2016). Within the context of hazards research, the concept of disaster resilience has been discussed for several decades, but it remains an ill-defined construct (Berkes & Ross, 2013). Disaster resilience can be defined as a process, an outcome, a set of adaptive capacities, or a combination of these definitions (Becker, Paton, & McBride, 2013; Berkes, 2007; Bruneau et al., 2003; Klein, Nicholls, & Thomalla, 2003; Manyena, 2006; Norris, Stevens, Pfefferbaum, Wyche, & Pfefferbaum, 2008; Paton, 2006a).

The definition of disaster resilience used for this thesis is as follows:

> Disaster resilience is society's capability to draw upon its individual, collective and institutional resources and competencies to anticipate, cope with, adapt to, recover from and develop/learn from the demands, challenges and changes encountered before, during and after disaster (Paton, 2007, p. 7).

This definition takes on a holistic conceptualisation of resilience by encapsulating its multi-scalar and multi-dimensional characteristics. It acknowledges that resilience encompasses all phases of a disaster: hazard mitigation,[1] preparedness,[2] response,[3] and recovery.[4] It also recognises that resilience characteristics exist and are intertwined at all levels of society: individual, household, group, neighbourhood, city, region, and nation. Furthermore, it considers the static and dynamic nature of resources and competencies – people and groups possess pre-existing skills and assets and have the ability to learn and adapt.

1.4 A related concept of disaster resilience: Social vulnerability

The examination of disaster resilience requires a consideration for a related concept, social vulnerability, which refers to the socioeconomic attributes and features (e.g., income level, gender, age, and health status) that impede the ability of individuals and groups to anticipate, respond to, and recover from a hazard event (Jörn Birkmann, 2006a; Wisner, Blaikie, Cannon, & Davis, 2004). The concept of social vulnerability evolved in the social sciences in the late 1970s and early 1980s to examine the underlying social, economic, political, and environmental interactions that shape the differential post-disaster outcomes experienced by groups with different sociocultural and demographic characteristics and access to resources and institutional networks (Jörn Birkmann, 2006b; Cannon, Twigg, & Rowell, 2003; Downing et al., 2005).

Cutter et al. (2008a) provided a succinct summary of the conceptual relationships between disaster resilience and social vulnerability. For some, disaster resilience is viewed as an inverse of social

[1] *Hazard mitigation* is defined as the lessening or limitation of the adverse impacts of hazards and related disasters by various strategies and actions (UNISDR, 2009, p. 19).
[2] *Preparedness* is defined as the knowledge and capacities developed by governments, professional response and recovery organisations, communities and individuals to effectively anticipate, respond to, and recover from, the impacts of likely, imminent or current hazard events or conditions (UNISDR, 2009, p. 21).
[3] *Response* is defined as the provision of emergency services and public assistance during or immediately after a disaster in order to save lives, reduce health impacts, ensure public safety and meet the basic subsistence needs of the people affected (UNISDR, 2009, p. 24).
[4] *Recovery* is defined as the restoration, and improvement where appropriate, of facilities, livelihoods and living conditions of disaster-affected communities, including efforts to reduce disaster risk factors (UNISDR, 2009, p. 23).

vulnerability. In this view, the ability of people to effectively respond to a hazard event is dictated by their access to material resources and means of protection; marginalised groups are thereby more vulnerable, and therefore deemed to be less resilient, to disaster consequences (Gaillard & Jigyasu, 2016; Manyena, 2006). For others, including the author of this thesis, disaster resilience and social vulnerability are viewed as conceptually different but related (Cutter et al., 2008a; Miles, 2015). This latter conceptualisation of social vulnerability proposes that while vulnerable groups have disproportionally poor access to resources, they also have inherent capabilities such as strong social networks that do allow them to effectively respond to different phases of a disaster. An example is a women's social network in an African-American community in New Orleans whose daily interactions through reciprocal assistance in childcare and job referrals contributed to their effective evacuation response prior to the landfall of Hurricane Katrina (Litt, 2008).

While the lens of social vulnerability focuses on the deficits of community members, the perspective of disaster resilience offers an asset-based pathway for capacity building for people and groups living in areas that are at-risk of natural hazards. Instead of viewing people and groups as helpless entities, adopting a disaster resilience lens involves making an explicit assumption that they possess inherent strengths and capacities that could facilitate disaster preparedness, response, and recovery. Adopting the work by Cutter et al. (2008a), Figure 1.9 illustrates these conceptual differences across different phases of a disaster. A group has inherent vulnerabilities (e.g., lack of access to resources due to income) and inherent resilience (e.g., strong social networks) prior to a hazard event. Following a hazard event, the degree of recovery is predicated on a group's ability to deploy adaptive processes and capacities that mitigate their pre-existing vulnerabilities.

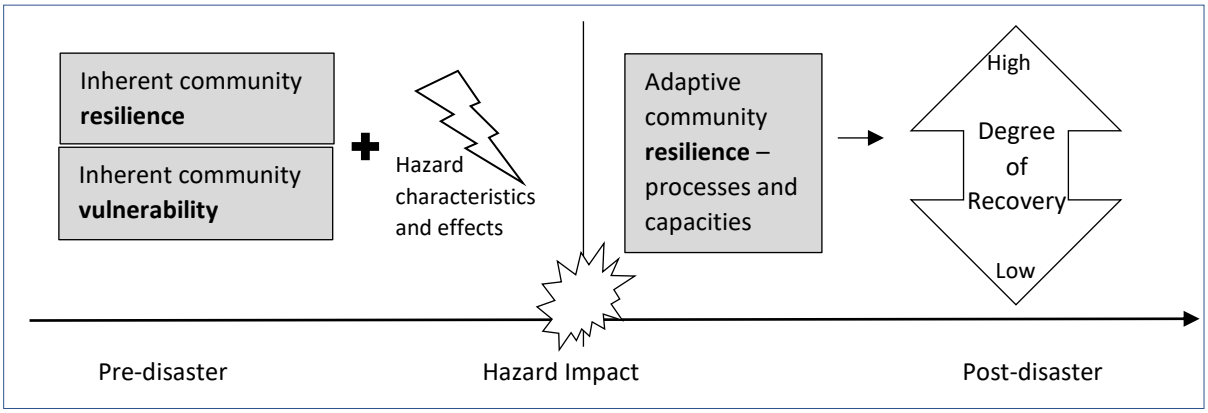


Figure 1.9 Temporal extent of vulnerability and resilience concepts in a disaster. Adapted from "A place-based model for understanding community resilience to natural disasters", by S. L. Cutter, L. Barnes, M. Berry, C. Burton, E. Evans, E. Tate, and J. Webb, 2008a, *Global Environmental Change, 18*(4), p. 602.

In sum, social vulnerability focuses on differential accessibility to and distribution of resources. In contrast, disaster resilience emphasises the capacities of people and groups in overcoming their vulnerabilities and consequences of hazard events. Addressing the social vulnerabilities and enhancing the resilient capacities of people and groups are both essential to building disaster resilience of neighbourhoods. Reducing social vulnerabilities requires structural transformation in economic, political, and social systems that have created differential access to resources. Taking a resilience lens allows for opportunities to understand what capacities (e.g., knowledge, skills, and processes) are needed and are present at all levels of society – from community groups to governments – to better prepare for, respond to, and recover from disasters. The latter approach requires rethinking how disaster risk reduction policies and practices can enhance existing capacities identified by local stakeholders.

1.5 Building community disaster resilience as a policy imperative

The devastating consequences of recent earthquakes and other natural hazard events in communities and nations have propelled governments at all levels to develop policies that promote community disaster resilience. Internationally, the Hyogo Framework for Action (HFA) ushered in global awareness and emphasis on building resilience at all levels of society, with a focus on disaster risk reduction[5] (DRR) as a pathway to reduce disaster losses (UNISDR, 2005). The HFA sets out strategies for integrating disaster risk into development planning; strengthening institutions, mechanisms, and capacities for building resilience; and focusing on risk reduction in disaster preparedness, response and recovery programmes (UNISDR, 2005).

In 2015, global leaders adopted 17 Sustainable Development Goals (SDGs) as part of the 2030 Agenda for Sustainable Development, which calls for countries around the world to work collaboratively to end poverty, build just and inclusive societies, protect human rights and promote gender equality, and to protect the planet and its natural resources (United Nations, 2015). Realising that the SDGs cannot be achieved without addressing the consequences of disasters, the Sendai Framework for Disaster Risk Reduction was passed following the development agenda to affirm that disaster risk reduction needs to be integral to sustainable development (UNISDR, 2016).

[5] Disaster risk reduction (DRR) refers to the concept and practice of reducing disaster risks through systematic efforts to analyse and manage the causal factors of disasters, including through reduced exposure to hazards, lessened vulnerability of people and property, wise management of land and the environment, and improved preparedness for adverse events (UNISDR, 2009).

The Sendai Framework for Disaster Risk Reduction extends the HFA's focus on reducing hazard risks and vulnerabilities in communities with the goal to reduce human, economic, and infrastructural losses and disruptions by mainstreaming disaster risk polices at the national and local levels (UNISDR, 2015b). It includes seven global targets in reducing disaster impacts and addressing the underlying drivers of disaster risk, all of which serve to safeguard current and future development gains (UNISDR, 2015b). Specifically, it draws attention to the need for understanding, assessing, and monitoring disaster risks, as well as integrating resilience building into national and local plans and programmes. To achieve these objectives, the framework specifically calls for the sharing of DRR responsibilities across an array of governmental and non-governmental stakeholders, including civil society, volunteers, and voluntary work and community-based organisations. Non-governmental actors are essential to providing "specific knowledge and pragmatic guidance" in the development of DRR frameworks, standards, and plans, as well as contributing to the creation of a culture of preparedness and advocating for resilient communities (UNISDR, 2015b, p. 23).

Against this international backdrop of increased focus on building community disaster resilience, numerous countries have begun to prioritise DRR in their regulatory and legal disaster management[6] frameworks (International Federation of Red Cross and Red Crescent Societies & United Nations Development Programme [IFRC], 2014). The focus on disaster risk reduction in resilience building includes a range of policies and legislations that support national and local activities in many different countries. They relate to building and land use regulations, environmental and natural resource management laws, climate change laws, insurance or other risk-sharing mechanisms, education and public awareness, and civic society and community participation (IFRC, 2014).

While countries are increasingly integrating DRR into their legal frameworks, significant policy and legislative gaps in supporting local level DRR actions remain. For instance, the 2011 International Conference of the Red Cross and Red Crescent Societies highlighted the need for more community-level DRR information, engagement, and resources (IFRC, 2014). The conference resulted in recommendations to national and local governments for legislation that makes community-based DRR activities and funding allocation a priority, as well as promoting the involvement of local stakeholders, other civil society organisations, and the private sector in community-level DRR activities. In addition to these recommendations, Scolobig et al. (2015) highlight the necessary conditions needed for community-based DRR to succeed, including cultivating reciprocal expectations concerning DRR responsibilities across government, public, and private stakeholders; aligning planning outcomes between stakeholder groups; and building local organisational structures

[6] Disaster management can be defined as the organisation and management of resources and responsibilities for addressing all aspects of emergencies, in particular, preparedness, response and initial recovery steps (UNISDR 2009).

that can respond and adapt to changing environmental and disaster conditions. DRR policies that seek to advance a shared responsibility model for disaster resilience between the state and local communities require taking these factors into consideration (Scolobig et al., 2015).

In the countries of New Zealand and the United States where this research took place, building community disaster resilience through DRR is emphasised in their respective disaster management frameworks. In New Zealand, the National Civil Defence Emergency Management Strategy has adopted the vision of a "Resilient New Zealand – Communities Understanding and Managing their Hazards" as part of the Civil Defence and Emergency Management Act 2002 (Ministry of Civil Defence and Emergency Management [MCDEM], 2008, p. 6). The strategy recognises that "knowing a community's perspectives, expectations and needs, and how these are likely to change over time, is crucial to hazard management across reduction, readiness, response and recovery" (MCDEM, 2008, p. 6). This strategy will be replaced with the new National Disaster Resilience Strategy in late 2018. The new strategy shifts the focus from "managing disasters" to "managing disaster risks" and promotes "all-of-society ownership of disaster resilience" as a means to achieve its vision of resilience (MCDEM, 2018). Specifically, the strategy focuses on four key priority areas:

- Understanding disaster risk;
- Strengthening disaster risk governance to manage disaster risk;
- Investing in disaster risk reduction for resilience; and
- Enhancing disaster preparedness for effective response, and to 'Build Back Better' in recovery, rehabilitation and reconstruction (MCDEM, 2018).

In the United States, where disaster management is under the jurisdiction of state and local governments, there is a National Preparedness Goal that sets the vision for a resilient nation and identifies core capabilities that are necessary for the nation to achieve readiness across the disaster cycle (U.S. Department of Homeland Security, 2011b). Aligning with the National Preparedness Goal, the U.S. government also developed the National Disaster Recovery Framework to provide guidance for recovery managers in disaster-impacted states, tribes, territorial and local jurisdictions to work collaboratively to "restore, redevelop, and revitalize the health, social, economic, natural, and environmental fabric of the community and build a more resilient Nation" (U.S. Department of Homeland Security, 2011a, p. 1).

1.5.1 From national policies to local actions

Propelled by the Rockefeller Foundation's 100 Resilient Cities (100RC) initiative, translating national DRR policies to local actions is gaining momentum (The Rockefeller Foundation, 2015). The 100RC

initiative was created by the Rockefeller Foundation in 2013 to support cities around the world to become more resilient to natural hazards, as well as day-to-day and cyclical socioeconomic stresses that weaken the functionality of a city (The Rockefeller Foundation, 2015). As defined by the 100RC, resilience is "the capacity of individuals, communities, institutions, businesses, and systems within a city to survive, adapt, and grow, no matter what kinds of chronic stresses and acute shocks they experience" (The Rockefeller Foundation, 2018b). This definition is broader in how it defines a hazard event than the definition adopted by this thesis (see Section 1.3), since chronic stresses and acute shocks could have natural or human-made origins. However, the definitions are similar in that both highlight the need for a cross-section of society to adapt, learn, and grow from the consequences of a hazard event.

The City and County of San Francisco became the inaugural city of the 100RC initiative in 2013 (City and County of San Francisco, 2016a), and the city of Wellington was selected in 2014 (Wellington City Council, 2017). As part of the 100RC coalition, both cities created a resilience strategy (The Rockefeller Foundation, 2018a). Wellington's resilience strategy covers the entire Wellington region including neighbouring cities and towns as disaster management for the region is managed by a single government agency, the Wellington Region Emergency Management Office (WREMO) (Greater Wellington Regional Council, 2017). San Francisco is a consolidated city and county whose overall resilience strategy is supported by the San Francisco Department of Emergency Management (SFDEM) (City and County of San Francisco, 2016a). The membership of these two regions in the 100RC initiative, has catalysed efforts to strengthen the capability of their communities to mitigate and respond to major natural hazard events.

Common to both regions' 100RC-sponsored resilience strategies is a focus on building community disaster resilience to earthquake hazards. Central to Wellington's disaster resilience strategy are three pillars: building connected and empowered communities, adopting integrated and informed decision-making processes at all levels of society and across all disaster phases, and ensuring robust built and natural environments (Wellington City Council, 2017). The key objectives for each pillar are described in Table 1.2. The San Francisco resilience strategy consists of four goals: plan and prepare for tomorrow; retrofit, mitigate, and adapt; ensure housing for San Franciscans today and after a disaster; and empower neighbourhoods through improved connections (Table 1.3) (City and County of San Francisco, 2016a). Similarities between these two strategies include building community disaster resilience through land use planning, retrofitting and building earthquake-resilient buildings and infrastructures, promoting robust economies, and building connected communities.

Table 1.2 *Goals and key objectives of the Wellington Resilience Strategy*

Resilience Goal	Key objectives
Connected and empowered communities	Enable all Wellingtonians to have an opportunity to enhance wellbeing for themselves and their communities; develop innovative programmes that connect and empower communities to improve their wellbeing; support the business community to improve preparedness and strengthen economic activity
Integrated and informed decision-making processes	Ensure resilience is integrated into governance; make information on all aspects of living in Wellington easily accessible; raise awareness about the potential effects of climate change and sea-level rise, and develop an adaptation plan; develop a framework for successful recovery from any disruption
Healthy and robust homes, built and natural environment	Promote Wellington homes as the cornerstone of the city's resilience; ensure that Wellingtonians always have access to water services; ensure flexibility and robustness of transport and energy services

Note. From "Wellington resilience strategy", by Wellington City Council, 2017.

Table 1.3 *Goals and key objectives of the San Francisco Resilience Strategy*

Resilience Goal	Key objectives
Plan and prepare for tomorrow	Prepare for San Francisco's recovery; advance innovations in earthquake preparedness; invest in infrastructure and transportation
Retrofit, mitigate, and adapt	Retrofit seismically dangerous buildings; retrofit and rebuild seismically hazardous infrastructure; mitigate and adapt to climate change
Ensure housing for San Franciscans today and after a disaster	Develop post-disaster housing recovery strategies; enhance systems to rapidly house San Franciscans; increase affordable housing stocks
Empower neighbourhoods through improved connections	Build strong, healthy and connected neighbourhoods; improve access to San Francisco government; establish the Office of Resilience and Recovery

Note. From "Resilient San Francisco", by City and County of San Francisco, 2016a.

While all of these approaches to creating disaster resilient communities are essential, due to time and financial constraints, this research focused on the social component of disaster resilience: social resilience. Social resilience is defined as the resilience of a social unit or a group to collectively cope with or respond to external stresses and disturbances resulting from social, political, and environmental changes (Adger, 2000). In addressing the resilience of the social environment, for example, WREMO has dedicated a third of its resources to working with and empowering communities in the event of a disaster (Wellington City Council, 2017). It has invested heavily in programmes to build social networks and foster cooperation among individuals, organisations, and communities that enable them to address everyday challenges and those brought on by a major

hazard event (Wellington City Council, 2017; Wellington Region Emergency Management Office [WREMO], 2012).

In San Francisco, a range of government and non-government agencies such as the Neighborhood Emergency Response Team (NERT) and the Neighborhood Empowerment Network (NEN) work with local communities to reduce their risks to multiple natural hazards (e.g., earthquakes, climate change, sea level rise) and to build their capacity to prepare for and cope with hazard event consequences (City and County of San Francisco, 2016a). In particular, NEN engages individual neighbourhoods to develop neighbourhood-based resilience plans that identify vulnerable populations and assess social services' capacity (Empowered Communities Program, 2016; Neighborhood Empowerment Network, 2014).

Given the actions taken and the significant resources invested by these two regions to build social resilience of communities, it is essential to evaluate their effectiveness in achieving their stated objectives. The first step towards evaluating resilience progress is to baseline community resilience levels. The next section provides the policy context for assessing community resilience as policy mandates at the national and local levels as they pertain to Wellington and San Francisco regions.

1.6 Assessing disaster resilience to disasters

While local governments and communities are adopting disaster resilience policies and translating them into resilience interventions, debates on how community disaster resilience can be measured have proliferated in recent years. Increasingly, policymakers, researchers, and practitioners are advocating for measuring community disaster resilience as a means to identify areas for improvement, evaluate resilience strategies, and monitor resilience progress (Committee on Increasing National Resilience, 2012).

The call for assessing community disaster resilience is explicitly integrated into national and local policies. Nationally, a capability assessment conducted as part of New Zealand's Civil Defence and Emergency Management Act (CDEM) has identified the need for measuring and tracking community resilience (MCDEM, 2012). To support this objective, the New Zealand government has recently launched the Resilience to Nature's Challenges initiative, which provides multi-year funding for research institutions across the nation to build new knowledge and tools that address resilience across a range of natural hazards in urban, rural, coastal, and Māori communities (Ministry of Business Innovation and Employment, 2016). As part of the initiative, one of the tools to be developed is a set of national-level resilience indicators that will be used by local and national

government agencies to baseline, monitor, and evaluate resilience progress (Ministry of Business Innovation and Employment, 2018).

In the U.S., the National Preparedness Goal and the National Disaster Framework both call for assessing and tracking pre-disaster conditions to enable a range of stakeholders at all levels of society to make informed disaster risk management actions (U.S. Department of Homeland Security, 2011b, 2011a). FEMA, which is tasked with carrying out the National Disaster Recovery Framework, is working with the National Oceanic and Atmospheric Administration to identify resilience indicators and measures at the national level, with the goal of developing common indicators of community resilience to help inform and prioritise policies, capacity-building strategies, and outcomes (FEMA, 2016). A set of preliminary indicators has been proposed that align with the National Preparedness Goal's ten core capacities: housing, health and social services, economy recovery, infrastructure systems, natural and cultural resources, threats and hazards identification, risk and disaster resilience assessment, planning, community resilience, and long-term vulnerability reduction (FEMA, 2016).

At the local level, both Wellington and San Francisco have implemented assessments in a variety of areas. Both are assessing and evaluating the resilience of buildings and infrastructures (City and County of San Francisco, 2018a; Wellington City Council, n.d.). In Wellington, WREMO is tasked with identifying a set of indicators and related measurements that serve to baseline existing resilience levels in the region and to act as a guide for evaluating the agency's policies and programmes (WREMO, 2012). In San Francisco, several government agencies have developed different types of assessments to address extreme heatwave events (San Francisco Department of Public Health, 2014) and identify neighbourhood-based physical assets and resources (Neighborhood Empowerment Network, 2014). Both regions have developed or are in the process of developing indicators and measures for broad-spectrum resilience, but are making limited efforts toward developing measures of social resilience for neighbourhoods, which are at the frontline in responding to disasters (Gaillard & Mercer, 2013).

1.6.1 Assessing disaster resilience by whom, for whom, and to what end?

As these two regions seek to assess existing levels of neighbourhood resilience, this section introduces the tensions around how resilience indicators are developed, what they measure, and what purpose they serve for communities being evaluated. Gaillard and Jigyasu (2016, p. 62) put these tensions succinctly, "Do those who are facing disasters triggered by natural and other hazards need their resilience to be measured, especially by outsiders, and who is benefitting from such measurements?"

While there is consensus among emergency management practitioners, policymakers, and researchers on the importance of measuring resilience (Committee on Increasing National Resilience, 2012; Cutter, Burton, & Emrich, 2010), this question raises important issues around power and power relations between those who develop the measures and those being assessed, as well as whose knowledge and experiences count in the development and implementation of resilience measurements (Gaillard & Jigyasu, 2016; Gaillard & Mercer, 2013). For instance, how measurements are developed and what gets measured reflect the voices and needs of those who are being included in the planning process (Gaillard & Jigyasu, 2016). While resilience assessments can provide local stakeholders valuable information about their neighbourhoods, they can also be a source for community marginalisation if the assessment process excludes community participation and produces measurement results that are disconnected from actual neighbourhood dynamics and needs, vulnerabilities, and assets (Gaillard & Jigyasu, 2016; IFRC, 2016; Vallance, 2011a). As international, national, and local disaster risk management policies increasingly advocating for empowering communities to take upon DRR actions, questions around how resilience measurements can be used as a tool for community empowerment or disempowerment in DRR planning will need to be examined. The issue of inclusion in the development of resilience assessment is further discussed in Chapter 2.

If local interventions are to be effective in building the capacity of people and groups to anticipate, respond to, and recover from disasters, it is essential to involve a broad spectrum of stakeholders to ensure "a common understanding of what resilience means for a community, a set of achievable milestones and goals, the approaches for reaching those milestones, and agreed-upon measures of progress are [developed] by the people, businesses, and government agencies associated with that community" (Committee on Increasing National Resilience, 2012, p. 19). Thus, this thesis explores opportunities for co-producing a disaster resilience measurement framework as a means for bridging the knowledge gaps between scientific and local knowledge, and between outside (e.g., government officials and researchers) and inside (e.g., community residents) stakeholders. Using a participatory approach, it seeks to define what resilience means to different stakeholder groups that are involved in building neighbourhood disaster resilience, including those from governments, research institutions, and local communities, as well as to identify and derive key themes and measures that reflect their perceptions, values, and beliefs. The justification and use of this approach are discussed throughout this thesis.

1.7 Structure of thesis

This thesis is divided into four sections. The first section comprises this chapter (Chapter 1) and Chapter 2, both of which provide an overview and grounding for this research. This current chapter provides an overview of the hazard landscapes, in particular earthquake risks, of the study regions – Wellington, New Zealand, and San Francisco, U.S.; evidence of the need to build community disaster resilience; and a summary of the policy context as it relates to assessing community disaster resilience. Chapter 2 provides grounding for this research through a literature review on existing conceptualisations of disaster resilience and how community disaster resilience is assessed. The second section – Chapters 3 and 4 – details the thesis's methodology and methods employed. The third section – Chapters 5, 6, and 7 – consists of research findings that are presented as three manuscripts – two published and one submitted for publication. Chapter 5 discusses the definition of social resilience and proposes a disaster resilience measurement framework based on the perspectives of hazards researchers, emergency management practitioners, and policymakers. Chapter 6 examines how social resilience is viewed from the perspectives of neighbourhood stakeholders and presents a measurement framework that incorporates their perspectives. Chapter 7 delves into how various perspectives from different stakeholder groups can be synthesised to produce a set of assessment measures. Specifically, it puts forward a set of qualitative and quantitative measures on social capital, a component of social resilience. The last section, Chapters 8 and 9, provides a discussion and future directions of the research. Briefly, the overall structure of the thesis is as follows:

Chapter 1	Introduction
Chapter 2	Literature review
Chapter 3	Methodology
Chapter 4	Methods
Chapter 5	Paper 1: What is 'social resilience'? Perspectives of disaster researchers, emergency management practitioners, and policymakers in New Zealand
Chapter 6	Paper 2: A bottom-up approach to developing a neighbourhood-based resilience measurement framework
Chapter 7	Paper 3: Stakeholders' perspectives of social capital in informing the development of neighbourhood-based disaster resilience measurements
Chapter 8	Discussion
Chapter 9	Conclusion

This thesis consists of a mixture of conventional chapters (Chapters 1, 2, 3, 4, 8, and 9) and manuscripts that have either been published or submitted for publication in peer-reviewed journals (Chapters 5, 6, 7). Appendix 4 contains the 'Statement of Contribution' sheets for each of the papers, certifying the percent of contribution to each paper by the author of this research. Since each manuscript needs to be self-contained, some information such as rationale, description of research methods, description of limitations, and tables and figures, are repeated throughout the thesis. All references of the thesis are listed in a section that follows the concluding chapter and use the American Psychological Association 6th edition style of referencing.

Chapter 2 – Literature review

This chapter provides an overview of disaster resilience conceptual frameworks that have formed the basis for disaster resilience measurements. It discusses different types of resilience measurements and the rationale for developing neighbourhood-based resilience measures through an integrated stakeholder-perspective approach.

2.1 Framing disaster resilience

The conceptual framing of disaster resilience is as diverse as the various research disciplines that have studied it. Many frameworks and models have been developed that have shaped the discourse and evaluation of the concept and factors that contribute to (or impede) resilience building processes and outcomes. This section discusses four themes that generally encapsulate the conceptualisations of disaster resilience to date: resilience as a specific process; resilience to a specific type of natural hazard; resilience as societal capitals or dimensions; and resilience as a multi-scalar and multi-phased concept. While there are overlaps across these themes, the next few sections discuss the key distinguishing aspects across different types of conceptualisations, all of which point to a general consensus that disaster resilience is not about returning to pre-disaster conditions (or the status quo), but centres on the adaptive ability of and interconnected resilience components that exist in societies post disasters (Manyena et al., 2011). A summary of these conceptualisations is presented in Table 2.1, which delineates each framework's and model's resilience domains, resilience outcome(s), and distinguishing qualities.

2.1.1 Disaster resilience as specific processes

The first strand of resilience thinking focuses on a specific process or a set of processes, especially within the context of disaster governance, which pertains to the structural arrangement between institutional actors (e.g., governments and local organisations) and processes (e.g., norms, rules and regulations) that drive coordinated decision-making and action, with the goal of reducing disaster impacts and losses (Tierney, 2012). Research into disaster governance has focused on ways to enhance the efficacy of policies in reducing community vulnerability (e.g., Burby, 2006; Gaillard, 2010), promoting cross-sector integration and partnerships (e.g, Simo & Bies, 2007; Vogel et al., 2007), and creating a framework for decision-making processes that engages all segments of communities (King, 2008; Pearce, 2003).

An underlying theme across disaster governance research is adaptation. Nelson et al. (2007) stress the importance of adaptation, which is the "decision-making process and the set of actions

undertaken to maintain the capacity to deal with current or future predicted change" (p. 396). It involves social learning, critical thinking, and making adjustments to a system's characteristics or processes (Berkes & Ross, 2013; Matyas & Pelling, 2012; Nelson et al., 2007).

Similarly Matyas and Pelling (2012) conceptualise resilience through a focus on decision-making systems and processes. They assert that governments and communities shape risk-management policies in three different ways, from least to most comprehensive: resistance, persistence, and transformation (Matyas & Pelling, 2012). Resistance is characterised by a society's insistence on maintaining the status quo by focusing its policy efforts solely on risk mitigation, resisting any attempts to reorganise assets, capacities, or capabilities to reduce future risks. An example would be reinforcing an existing hazard mitigation structure – a sea wall – from the threat of tsunami to a community. Persistence corresponds to a community's effort to reorganise the same assets and capacities to return to a similar level of equilibrium. In contrast to resistance, risk mitigation strategies might be diversified. For instance, contingency planning is adopted to deal with a potential breach of the sea wall.

In the third state of risk management, transformation, a community undergoes a transformative adaptation process after a disaster through making changes in its risk-management policies that adapt to the demands of a new reality. This approach challenges pre-existing values, goals, and risk mitigation practices in order to change the risk management status quo. A transformational approach to risk management might include shifting existing land uses to reduce the exposure of the community from tsunami impacts.

While all of these approaches could be used simultaneously as part of an adaptation process in a disaster environment, reflexivity in decision-making within a system's constraints (e.g., time, money) guides which approach to use (Matyas & Pelling, 2012). Matyas and Pelling (2012) argue that reflexivity in decision-making is the "essence of resilience" (p. 47). As part of a governance process, reflexivity is either supported or obstructed by other governance considerations such as whether the decision-making process is democratic and equitable so that everyone benefits from the resulting outcomes of a decision, or whether the need for expediency in post-disaster planning forgoes innovation and experimentation in the development of solutions.

2.1.2 Disaster resilience to specific hazards

The second strand of thinking conceptualises disaster resilience with regard to a specific hazard or hazard type. One example is Bruneau et al.'s (2003) conceptualisation of resilience, which centres on seismic events. They argue that seismic resilience requires societal systems – physical or technical,

organisational, social, and economic – to demonstrate three qualities: reduced failure probabilities, reduced consequences from failures, and reduced time to recovery (2003). Central to achieving these qualities are four dynamic processes: robustness, redundancy, resourcefulness, and rapidity (Bruneau et al., 2003). Robustness describes the ability of a system to absorb and withstand the impacts of a hazard. Redundancy implies the substitutability of systems' components. Resourcefulness is characterised by the ability of system users to prioritise needs and procure the necessary capitals (e.g., human, financial, informational, or physical resources) to ensure the functionality of those systems. Rapidity refers to the length of time it takes for systems to return to functionality.

Another example is Joerin et al.'s (2012) climate-related disaster community resilience framework (CDCRF), which focuses on coastal hazards such as floods and cyclones. This framework highlights that communities facing such hazards need to meet high levels of functionality in three areas: critical lifelines (physical); health, education and awareness of hazards, and preparedness (social); and financial security (economic).

While an all-hazards framework can be applied to different geographic regions regardless of the types of hazards they face, resilience conceptualisations that focus on a specific hazard or a set of hazards limit their applicability to only regions where exposure of those hazards exist. Thus, the seismic resilience framework by Bruneau et al.'s (2003) is applicable to regions at are at risk of earthquakes and Joerin et al.'s (2012) CDCRF is developed for communities that are at risk of flooding and other coastal hazard events.

2.1.3 Disaster resilience as societal capitals or dimensions

Most existing conceptualisations of disaster resilience account for various societal capitals or dimensions that include a combination of social, cultural, political, economic, human, physical, and/or natural resources or systems. For instance, several disaster resilience frameworks view disaster resilience as "the ability of a community to appreciate, access, and utilize the major forms of capital" (Mayunga, 2007, p. 7; National Institute of Standards and Technology, 2015; Ritchie & Gill, 2011). One example is Ritchie and Gill's (2011) community capitals framework, which emphasises the importance of a community's ability to mobilise capital resources and postulates that community recovery depends on the awareness of responders, planners, and other local stakeholders of existing resources, how such resources can be used, and how to access them. This framework draws attention to the temporality of capital demands and stakeholders' values across various phases of a disaster, whereby some capitals are more valued at certain times than others. For example, capitals relating to the provision of water, food, and shelter and other lifelines are more critical immediately

following a disaster than are other resources. This framework provides a basis for examining competing interests in the restoration of specific forms of capital among different stakeholders (Ritchie & Gill, 2011).

Likewise, disaster resilience is also viewed as having different dimensions or functions. The PEOPLES framework, for example, highlights the seven dimensions that are essential for the evaluation and enhancement of resilience: population and demographics; environmental and ecosystem; organised governmental services; physical infrastructure; lifestyle and community competence; economic development; and social-cultural capital (Renschler et al., 2010). Another example is WISC's conceptualisation of community disaster resilience that encompasses two overarching concepts – infrastructure and community – and the four constructs the framework is named after: well-being, (community) identity, (social and physical) services, and capitals (Miles, 2015). The framework further delineates 29 variables across these four constructs for assessing disaster resilience of communities.

The more well-known Norris et al. (2008) conceptualisation of resilience comprises societal dimensions that include economic development, social capital, community competence, and information and communication. Their framework (2008) posits resilience as "a set of adaptive capacities and *community* resilience [as] a set of *networked* adaptive capacities" (p. 135). Adaptive capacities are defined as resources (i.e., capitals) with dynamic attributes (i.e., robustness, redundancy, rapidity) (Bruneau et al., 2003; Norris et al., 2008). Community resilience, therefore, is "a process linking a set of adaptive capacities to a positive trajectory of functioning and adaptation after a disturbance" (Norris et al., 2008, p. 130). Because adaptive capacities are a means to an end, community-level adaptation is characterised by a "high prevalence of wellness in the community, defined as high and non-disparate levels of mental and behavioural health, role functioning, and quality of life in constituent populations" (Norris et al., 2008, p. 133). Hence, Norris et al.'s (2008) conceptualisation of community resilience is tightly linked to population wellness and the functionality of different systems that contribute to it.

More recently, the highly profiled 100 Resilient Cities (100RC) initiative by the Rockefeller Foundation adopted a multi-dimensional approach to framing disaster resilience at the city level. The city resilience framework, as it is known, comprises four dimensions around the health and wellbeing of individuals, infrastructure and environment, economy and society, and leadership and strategy (The Rockefeller Foundation & ARUP, 2014). Similarly, de Boer, Muggah, and Patel (2016) introduced an analytical framework that integrates two concepts – fragility and resilience – as the basis for city-based assessments. A city's fragility focuses "on the real and relative legitimacy,

authority, and capacity of state institutions to fulfil [a city's] core functions" (de Boer et al., 2016, p. 2). Fragility factors include a variety of vulnerability factors such as income and social inequality, unemployment, natural hazard exposure, policy and justice deficits, and rapid and unregulated urbanisation. A city's resilience is dependent on its ability to deliver core functions before, during, and after exposure to shocks (de Boer et al., 2016). Factors that shape a city's resilience include effective policy and judicial mechanisms; social cohesion; microeconomic security and social protection; social networks and social support; greater income and social equality; strong community-government and inter-governmental cooperation; and the provision of basic services. Both the 100RC and de Boer et al.'s frameworks seek to address factors that can be shaped by city-level policies.

This section reveals differences and similarities in how societal capitals and dimensions are defined and categorised. Although these frameworks categorise societal dimensions in various ways, the underlying assumption among all of them is that disaster resilience comprises interrelated parts.

2.1.4 Disaster resilience as a multi-scalar and multi-phased concept

In addition to disaster resilience being multi-dimensional, it is a multi-scalar and multi-phased concept with properties that comprise various societal dimensions, processes, and outcomes across spatial and temporal scales. Several of these conceptualisations are described below.

One of the earlier disaster resilience frameworks was conceptualised by Tobin (1999), who postulated that resilience can be analysed by understanding three separate but linked components across various societal dimensions (e.g., social, economic, and political) and scales (e.g., local, national, and global). The three components are hazard mitigation, disaster recovery, and structural-cognitive functions. Hazard mitigation focuses on reducing exposure to and impact from hazard risks through developing the necessary conditions such as having clear policy objectives and capable leaders for effective policy implementation. Disaster recovery emphasises the restoration of societal capitals and infrastructures, coordination of policies and programmes among institutional players, and equitable distribution of resources after a hazard event. Hazard mitigation and disaster recovery are influenced by structural-cognitive influences. Structural factors include those stemming from systems that are institutional (e.g., policies on land use), social (e.g., age, gender, social networks), cultural (e.g., ethnic makeup), and economic (e.g., livelihoods). Combined with cognitive features such as attitudes and perceptions, they play an integral role in either enhancing or impeding mitigation or recovery efforts (Tobin, 1999). This trio of components provides a basis for creating resilient and sustainable communities.

Similar to Tobin's framework (1999) is a model of community resilience developed by Paton (2007a), which also focuses on not only structural but also cognitive resilience factors that exist at personal, community, cultural, and institutional and environmental levels. The Paton model consists of four general components: resources, competencies, planning and development strategies, and sustainability of resources and competencies (Paton, 2006a, 2007a). Resources include goods, plans, and infrastructure that protect people and organisations and enable the continuity of livelihoods and services after a hazard event. Competencies include individuals' and organisations' abilities to secure and use resources in response to the challenges posed by the event. Planning and development strategies help to ensure that resources and competencies are available when needed, are used to provide guidance on resource allocation before and after a hazard event, and offer a blueprint for anticipating future challenges and post-disaster growth. The last component of community resilience is the sustainability of resources and competencies throughout the disaster cycle. Underlying these four components is a focus on the cognitive dimension (i.e., mental processes and perceptions), which is involved with the interdependencies of people's values and beliefs, household- and community-level social capital, and institutional processes, as well as how these interdependencies facilitate recovery and sustainable development in the aftermath of major disasters (Paton, Mamula-Seadon, & Selway, 2013). In essence, resilience is "a measure of how well people and societies can [anticipate] and adapt to a changed reality" (Paton, 2006a, p. 8).

A well-known conceptualisation of disaster resilience is based on Cutter et al.'s (2008a) disaster resilience of place (DROP) model. Unlike other previous conceptualisations reviewed, DROP takes into account not only the multi-dimensionality of resilience but also the impacts that social vulnerability factors have on subsequent community resilience. According to this model, resilience is the ability of a social system to respond to and recover from disasters. It links vulnerability, adaptive capacity, and factors that contribute to community resilience, including conditions that enable a "post-event, adaptive process that facilitates the ability of the social system to reorganize, change, and learn in response to a threat" (Cutter et al., 2008a, p. 599). Each social system possesses inherent vulnerable and resilient conditions that allow it to absorb impacts and cope with hazard events. These inherent conditions are neither mutually exclusive nor inclusive; some factors (e.g. education) overlap as they influence resilience and vulnerability in different ways. Furthermore, Cutter et al. (2008a) stress that disasters are place-based and event-specific. As such, the DROP model centres on community-level conditions instead of those that exist at the macro level. Overall, resilience is the interplay among antecedent conditions (inherent vulnerability and resilience), hazard event characteristics, coping responses, adaptive capacity in response to hazard impact, and

adaptive resilience (i.e., improvisation and social learning), as well as the presence or absence of mitigation and preparedness activities that either attenuate or amplify these processes.

While each of these frameworks encapsulates different aspects of the concept of resilience, a common feature among them is that resilience is no longer seen as merely a returning to pre-disaster conditions, or bouncing back (Manyena et al., 2011). Rather, resilience is about bouncing forward, with a focus on the ability of people and institutions to adapt to changes or the new status quo (Manyena et al., 2011). Adaptation through social learning is central to the prevailing conceptualisations of resilience (Manyena et al., 2011). Additionally, resilience is also conceptualised as multi-dimensional and multi-scalar, relating to three interconnected components: scales of resilience, resilience domains, and resilience characteristics. Scales of resilience address the temporal, spatial, and institutional levels of resilience. The temporality of resilience refers to not only the length of onset of hazard events, but also the different phases of a disaster, from mitigation and preparedness through response to physical and social recovery. Resilience also spans different spatial and institutional levels, whether local, sub-national, or national levels across individual, household, or organisational extents. Resilience domains are the various societal dimensions of the concept, including physical, economic, social, or natural systems, and its characteristics include factors within each system that either contribute to or impede its ability to recover and adapt from a disaster.

While this thesis cannot address disaster resilience in all its dimensions due to time and financial constraints, it examines one aspect of disaster resilience – social resilience – that has captured the attention of hazards researchers, practitioners, and policymakers as a key component to building disaster resilient communities (Adger, 2000; Paton, Johnston, Mamula-Seadon, & Kenney, 2014). As a component of disaster resilience, social resilience is the ability of a social unit or a group to collectively cope with and respond to external stresses and disturbances (Adger, 2000). As discussed previously and in subsequent chapters, the concept of resilience is fraught with varying interpretations. Therefore, the following chapters discuss how social resilience has been conceptualised in the literature and by various stakeholder groups in the thesis's study regions and how such conceptualisations can contribute to the development of resilience assessments.

Table 2.1 *Disaster resilience conceptual frameworks, their domains, stated resilience outcome(s), and distinguishing qualities*

Framework	Key resilience domains addressed	Resilience outcome(s)	Distinguishing qualities
Resistance, persistence and transformation framework (Matyas & Pelling, 2012)	Resistance: system or component remains at status quo (policies focus on risk mitigation). Persistence: system re-organises its assets, capacities or capabilities, enabling a return to a similar equilibrium. Transformation: pushes the system towards a different status quo through 1) enlarged scale or intensity of existing risk reduction technologies, 2) far-reaching and novel adaptation, and/or 3) adaptations that change the nature of places and locations.	Changes in risk management systems and processes	Singularly focuses on risk management decision-making systems and processes
Bruneau et al. (2003)	Robustness: the ability of a system to withstand a given level of stress without degradation or loss of function. Redundancy: the extent to which a system is substitutable. Resourcefulness: the capacity to identify problems, establish priorities, and mobilise resources when a system is under threat. Rapidity: the capacity of a system to achieve goals in a timely manner in order to contain losses and avoid future disruption. Robustness, redundancy, resourcefulness, and rapidity (4 R's) across four dimensions: technical (physical systems), organisational (organisations), social (communities and governments), and economic (relating to economic losses).	Reduced failure probabilities. Reduced consequences from failures, in terms of lives lost, damage, and negative economic and social consequences. Reduced time to recovery (restoration of a specific system to their 'normal' level of performance)	Useful for addressing infrastructural resilience and how it affects other dimensions (e.g., social, economic)
Climate-related Disaster Community Resilience Framework (Joerin et al., 2012)	Physical (electricity, water, sanitation and solid waste), social (health, education and awareness, social capital, preparedness), and economic (income and employment situation, household assets, finance and saving).	Enhanced household adaptive capacities following a disaster	Accounts for social learning from past disasters (i.e., disaster experience)
Community capitals framework (Mayunga, 2007; Ritchie & Gill, 2011)	Social, cultural, political, economic, human, physical, and natural.	Resilient and sustainable recovery through broad-based participatory pre- and post-disaster planning process	Emphasis on the cultivation and mobilisation of community capitals/assets
PEOPLES resilience framework (Renschler et al., 2010)	Population and demographics; environmental/ecosystem; organised governmental services; physical infrastructure; lifestyle and community competence; economic development; and social-cultural capital.	Service functionality for each domain	Framing resilience through a landscape perspective
WISC theoretical framework (Miles, 2015)	Community: well-being (affiliation, satisfaction, autonomy, material needs, health, security) and identity (equity, esteem, empowerment, diversity, continuity, efficacy, distinctiveness, adaptability). Infrastructure: services (rivalrousness, excludability, redundancy, robustness, centrality, gravity, marketability, substitutability, connectedness) and capitals (cultural, social political, human, built, economic, natural).	Demonstrated pre- and post-disaster resilience across the four constructs in human settlements	Including community identity as a core component to the conceptualisation and assessment of community disaster resilience

Networked adaptive capacities (Norris et al., 2008)	Information and communication (narratives, responsible media, skills and infrastructure, trusted sources of information); economic development (fairness of risk and vulnerability to hazards, level of diversity of economic resources, equity of resource distribution); social capital (received and perceived social support, social embeddedness, organisational linkages and cooperation, citizen participation/leadership and roles, sense of community, attachment to place); community competence (community action, critical reflection and problem solving skills, flexibility and creativity, collective efficacy/empowerment, political partnerships).	Adaptation of societal functions to support population health	Linking adaptive capacities to the psychological and behavioural health and well-being of people and communities
100 Resilient Cities' City Resilience Framework (The Rockefeller Foundation & ARUP, 2014)	Leadership and strategy, health and wellbeing, economy and society, infrastructure and environment.	The capacity of cities to function, survive and thrive after stresses or shocks.	Focus at city-level resilience
City fragility and resilience (de Boer et al., 2016)	Fragility: income and social inequality; concentrated poverty; unemployment; natural hazard exposure; real and perceived insecurity; policy and justice deficits; and rapid and unregulated urbanisation. Resilience: effective policy and judicial mechanisms; social cohesion; microeconomic security and social protection; social networks and social support; greater income and social equality; strong community-government and inter-governmental cooperation; provision of basic services.	Ability to restore and deliver core city functions.	Integration of fragility and resilience concepts and measurements
Sustainable and resilient communities' framework (Tobin, 1999)	Mitigation (theories and goals, capable agencies, leadership and politics, constituency support); recovery (re-accumulation of capital, government policies and relief aid, resource distribution); structural factors (societal changes; situational factors: physical location, age, income, health, education, gender, social networks); cognitive factors (psychological, attitudinal).	Sustainable and resilience communities	Integration of mitigation, structural/cognitive, and recovery factors in contributing to sustainability outcomes
Model of community resilience (Paton, 2007a)	Individual (negative outcome expectancy, denial/fatalism, positive outcome expectancy, action coping/self-efficacy, critical awareness); community (place attachment, sense of community, community participation, collective efficacy); societal/institutional (empowerment settings, trust).	Adaptive capacities during immediate impact, impact, response, and rebuilding/recovery	Incorporation of cognitive factors (e.g., attitudes, values, and beliefs) pertaining to people, systems, and processes at multiple spatial scales
Disaster resilience of place model (Cutter et al., 2008a)	Antecedent/inherent conditions (social systems, built environment, natural systems); hazard event characteristics; coping responses; adaptive resilience.	Degree of recovery	Focus on community-level inherent vulnerability conditions

2.2 Typology of resilience assessments

As local governments seek to measure pre-disaster levels of resilience as part of the drive to evaluate capacity and capability gaps, the number of assessments that have sought to operationalise and evaluate the concept of resilience has increased dramatically. Many existing resilience assessments have drawn from the theoretical conceptualisations of resilience described in Section 2.1. For example, the disaster resilience of place (DROP) model has given rise to various resilience assessments, including the benchmarking resilience indicators for communities (BRIC) (Cutter et al., 2014, 2010) and other resilience assessments (e.g., Zhou, Wang, Wan, & Jia, 2010). In another instance, the capital-based framework forms the basis for the National Institute of Standards and Technology's (NIST) community planning guide (NIST, 2015) and the proposed national resilience assessment framework for New Zealand (Stevenson et al., 2015). Furthermore, various resilience measures have been developed based on Paton's model of community resilience (e.g., Khalili, Harre, & Morley, 2015; Paton, 2007a; Paton, Okada, & Sagala, 2013).

Section 2.2.1 first describes the three properties of resilience assessments – focus, domain, and spatial. In Sections 2.2.2 to 2.2.4, the three types of assessments – quantitative, qualitative, and self-assessment – will be discussed. A summary of disaster resilience assessment properties and types is outlined in Table 2.2.

Table 2.2 *Types and distinguishing properties of disaster resilience assessment*

Method	**Quantitative**	**Qualitative**	**Participatory**
Resilience viewpoint	Resilience as an outcome	Resilience as a process	Resilience as through the lens of local people
Role of outsiders (e.g., researchers, practitioners)	Data collector	Observer	Facilitator
Role of local people	Passive respondents	Actors of their everyday lives	Analysts
Data collection mode	Extractor	Interactive	Self-organising
Contribution to knowledge	Comparable numbers	Social and cultural insights	Diverse and local perspectives
Limitation	Generalisation of local variations	Lack of comparability	Lack of comparability
Property	Focus: An assessment of specific assets or a whole community and its attributes. Spatial: An assessment's unit of analysis, which ranges from individual communities to nations. Some assessments have no spatial unit if they measure a single dimension of resilience. Domain: Characteristics are quantities of some attributes present in a system/community, while capacities reflect the performance or quality embedded within a system/community.		

Note. From Cutter (2016) and Gaillard and Jigyasu (2016).

2.2.1 Assessment properties

Existing resilience assessments can generally be categorised by their four primary attributes – focus, domain, spatial unit, and method (Cutter, 2016). First, focus refers to whether an assessment evaluates specific community assets or a whole community and its attributes. The former is exemplified by resilience assessments of lifelines – services such as transportation, water, and electrical systems that are essential to daily lives (Chang & Nojima, 2001; Hopkins, Lumsden, & Norton, 1993; Johnson, 2014). The latter, broader view is approached by assessments such as the BRIC assessment that seeks to assess resilience across a range of societal domains, including social, economic, physical/built, institutional, and natural environments (Cutter et al., 2014, 2010).

The second attribute, an assessment domain, includes characteristics or capacities of communities or systems under investigation. Characteristics describe the quantity or presence of certain attributes within a community or a system. Capacities refer to the quality or performance of community or system characteristics and attributes, such as trust toward local leadership or quality of a community emergency plan (Cutter, 2016). It is not uncommon to have assessments that measure both characteristics and capacities of a community or a system. For example, the Rural Resilience Index assesses not only availability of lifelines (e.g., water availability) in rural villages, but also their quality (e.g., safety of water) (Cox & Hamlen, 2014).

Third, an assessment's spatial property identifies its geographic unit of analysis, ranging from individual households to neighbourhoods to nations. Certain assessments, such as the household disaster resilience toolkit by Arbon et al. (2016), focus on household preparedness, while city-level assessments are advocated by the 100 Resilient Cities initiative (The Rockefeller Foundation & ARUP, 2014). Selected assessments that focus at the neighbourhood level are listed in Table 2.4 in Section 2.4.4.

Last, the method of an assessment can be described as top-down or bottom-up using quantitative, qualitative, or participatory approaches (Cutter, 2016; Gaillard & Jigyasu, 2016). Because an assessment's methodology is an important characteristic that influences what gets measured, the following sections describe these three types of methodological approaches.

2.2.2 Quantitative assessment

The first approach to the assessment of disaster resilience is quantitative. Quantitative assessments seek to calculate various dimensions of resilience. The quantitative approach views disaster resilience as a measurable outcome, reducing it to a score, rank, or other forms of calculation (Gaillard & Jigyasu, 2016). Assessment types that adopt this approach include indexes and

scorecards (Cutter, 2016; Gaillard & Jigyasu, 2016; Rus, Kilar, & Koren, 2018). The physical dimension of resilience, for instance, is assessed through the probability of occurrence and magnitude of hazards, while the social dimension of resilience is quantified by assessing the extent of exposure to hazards and their consequences through the use of indicators and proxy variables (Gaillard & Jigyasu, 2016).

Quantitative assessments have proponents and critics. Assessments using a quantitative approach are usually 'top-down' or nomothetic, using generalised datasets at the city, regional, national, or international level to offer a sweeping overview of conditions for large areas (e.g., metropolitan areas, regions, nations) (Cutter, 2016). This type of assessment is conducive to comparing patterns of resilience across geographic localities, providing policymakers with a broad snapshot of resilience gaps (Cutter, 2016; Cutter et al., 2014; Gaillard & Jigyasu, 2016). However, assessments that rely on national or regional datasets run into issues around the accuracy of datasets, which are often out of date, thus providing inaccurate snapshots of resilience levels (Cutter, 2016). As a deeper critique, Gaillard and Jigyasu (2016) argue that such an approach is reductionist. They assert that quantitative assessments are "usually driven by 'experts' who design questionnaires and other extractive tools based on their generalized assumptions of what resilience is" instead of using a bottom-up approach that engages local stakeholders in assessing what resilience means to them (Gaillard & Jigyasu 2016, p. 40).

Furthermore, many assessments using a quantitative approach are devoid of local input, thus running the risk of generalising local dynamics and conditions by overlooking differences between places (Cutter et al., 2014; Fekete, Damm, & Birkmann, 2009; Hemphill, Berry, & McGreal, 2004; Mustafa, Ahmed, Saroch, & Bell, 2011). If input is considered from local stakeholders, they are "very often treated as passive respondents of surveys and other census" (Gaillard & Jigyasu, 2016, p. 40). As a result, the sole use of expert sources such as academic researchers and those from government institutions – who often are perceived as outsiders by local stakeholders– might result in assessments and interventions that are disconnected from the diverse values, priorities, and everyday experiences of people who would be most affected by disasters in the area being measured (Gaillard & Mercer, 2013; Sharifi, 2016). As King (2001) argues, the complexity of people and communities is too great to be reduced into a set of generalised albeit meaningful indicators.

2.2.3 Qualitative assessment

The second resilience assessment approach relies on qualitative data collection methods. Qualitative assessments provide rich descriptions that capture local context and dynamics, especially how people act and react to hazard events within the context of their environments (Gaillard & Jigyasu,

2016). Numerous qualitative studies have examined neighbourhood-based resilience through data collection tools such as semi-structured interviews, focus groups, and participant observations that enable outside researchers and practitioners to interact with and examine the perspectives of local people (Gaillard & Jigyasu, 2016). For example, through interviews, Chamlee-Wright and Storr (Chamlee-Wright & Storr, 2009b, 2010) examined the beliefs, attitudes, and cultural practices of individuals and communities that contributed to effective disaster response actions and motivated their return to their neighbourhoods. They found that sense of place and commonalities in cultural practices and lived experiences are essential to people's returning to their neighbourhoods (Chamlee-Wright & Storr, 2009b, 2010). Unlike quantitative assessments that examine disaster resilience as an outcome, qualitative studies such as the ones described seek to evaluate disaster resilience as a process or an attribute of people and places (Gaillard & Jigyasu, 2016).

While qualitative studies offer important insights into the intersection of structural and cognitive factors, their orientation toward understanding local contexts limits their abilities to be comparable across geographic areas (Gaillard & Jigyasu, 2016). For instance, most neighbourhood-based resilience assessments (e.g., Communities Advancing Resilience Toolkit (CART) Assessment Survey) (Pfefferbaum et al., 2013) seek to address issues of local contexts as they derive data locally, but up-scaling place-specific factors and datasets might not be pertinent for regional- or national-level analyses (Jörn Birkmann, 2006b; Cutter et al., 2014; Fekete et al., 2009).

However, qualitative examination of disaster resilience factors has gained significant traction that challenges top-down assessment approaches. Although the use of qualitative methods to produce disaster resilience measurements is still limited in practice (Gaillard, 2010), recent research studies use qualitative methods to capture essential attributes of disaster resilience across geographies. For example, a study by Paton et al. (2014) employed focus groups to examine factors that contributed to people's recovery from a wildfire in Australia and an earthquake in New Zealand. The outcome of that study refined Paton's model of community resilience (as discussed in Section 2.1.4.) (Figure 2.1).

Figure 2.10 Paton's resilience/adaptive capacity model illustrating adaptive capacities to respond to post-disaster demands at individual, family, community, and societal/agency levels. Reprinted from *Preparing for disaster: Building household and community capacity*, by D. Paton and J. McClure, 2013, p. 205.

2.2.4 Self-assessment through participation

Self-assessment through participation, the third approach to resilience assessment, is rooted in the belief that individuals and communities have the skills, knowledge, and resources to control the outcomes of disasters (Gaillard & Jigyasu, 2016). This approach views resilience through the lens of individuals and communities that face the risk of natural hazards. Although it has been widely recognised by the community development sector that engaging local stakeholders and incorporating their perspectives is essential to advancing community-based interventions (Agrawal, 1995), such practices have yet to be widely adopted within the disaster management field (Davies et al., 2015).

While participatory assessment can be quantitative, qualitative, or a combination of both approaches, the hallmark of participatory assessment is the involvement of all relevant stakeholders throughout the evaluation and planning processes: assessment design, identification of assessment measures, assessment implementation and data collection, and intervention or policy planning based on assessment results (Fraser et al., 2006). This type of assessment allows for the consideration of the diverse characteristics, practices, and beliefs of local stakeholders. Instead of

dictating what gets assessed, outside researchers and practitioners serve as a support to the assessment process and facilitate knowledge transfer from local levels to broader policies and interventions at city or regional levels (Gaillard & Jigyasu, 2016). One limitation to this approach is that, similar to qualitative evaluation of disaster resilience, the assessment method is geared toward place-specific contexts, making comparability between places challenging (Gaillard & Jigyasu, 2016). Still, since individuals and communities are on the frontline of disasters and possess knowledge and resources that are beyond the reach of outside researchers and practitioners, the development of self-assessment (or participatory assessment) is gaining currency within the disaster management sector as a means to shift control of disaster planning from government to neighbourhood-based actors (Gaillard & Jigyasu, 2016; Gaillard & Mercer, 2013). Such approach has been advocated by humanitarian organisations such as the Red Cross (Herbst & Yannacci, 2013).

2.3 Key dimensions and concepts addressed in disaster resilience assessment tools

As discussed in Chapter 1, the concepts of social vulnerability and disaster resilience are related. How these concepts are operationalised and measured in the literature highlight their similarities and their differences. This section summarises the two studies on social vulnerability and disaster resilience variables that were conducted by the author of this thesis as part of a separate research project for GNS Science.[7] These studies provided a foundation for assessing how social vulnerability and disaster resilience are measured. These studies were published as GNS Science reports (Kwok, 2016b, 2016a) (Appendices 5 and 6).

2.3.1 Concepts measured in social vulnerability assessments

The first study, entitled "Integrating social vulnerability indicators in RiskScape's earthquake risk modelling" (Appendix 5), was conducted as part of a project to assess the feasibility of integrating social vulnerability indicators in a hazard loss modelling software called RiskScape that was developed jointly by GNS Science and the National Institute of Water and Atmospheric Research (NIWA) in New Zealand (Kwok, 2016). The goal of the software is to improve community resilience to natural hazards by supporting planning and response activities of government councils and utility and infrastructure operators (Bell & King, 2009). As a loss modelling tool, it computes hazard exposure information into likely consequences for a region and provides decision-makers with

[7] GNS Science is a Crown Research Institute established by the New Zealand government that provides earth, geoscience, and isotope research and consultancy services for the public good (GNS Science, 2009b)

quantitative information on direct and indirect socioeconomic losses and casualties across a range of natural hazards (Bell et al., 2007; Bell & King, 2009).

In this study, 29 social vulnerability assessment tools were reviewed. Key social vulnerability concepts measuring different societal domains – built, economic, social, institutional, and natural environments – are presented in Table 2.3. The report also lists all the variables used to measure these concepts.

Table 2.3 *Main concepts measured by social vulnerability assessment tools*

Built environment	**Economic environment**
Location of community Physical description of community Infrastructure and access Technology/technical capacity Physical vulnerability Development pressure/capital construction Exposure and susceptibility	Economic stability and wellbeing Economic activities Dependence on agriculture Livelihood Unemployment Income deprivation/poverty Natural resource dependence Living standards
Social environment	**Institutional environment**
Health (including health services, sanitation, food and water, nutrition, and disabilities) Safety Community Social connections/networks/cohesion Conflict/social capital Civic participation Knowledge and skills Education Cultural traditions Human uses/activities Housing and transportation Population dynamics (including migration, rurality) Exposed people Lack of resilience Capacity to cope Demographics (including age and longevity, gender, household composition, dependent population, minority status/language)	Governance Politics Development Early warning capacities Institutional stability and strength of public infrastructure Organisational/institutional Global interconnectivity Policy indicators
	Natural environment
	Climactic conditions Ecology and ecosystems Quality of the environment Habitat change/ecological value Contaminant introduction Resource extraction activities Environmental health

Note. From "Integrating social vulnerability indicators in RiskScape's earthquake risk modelling", by A. H. Kwok, *GNS Science Report 2016/09*, p. 9.

The author of this report recommends that assessment indicators (i.e., a set of variables) need to address the needs and priorities of end-users of the modelling software (Kwok, 2016a). One particular assertion is that different stakeholder groups (e.g., emergency management practitioners, health practitioners) are partial to certain indicators and individual variables, such as health practitioners' needs to assess the scope of medically vulnerable populations, health access, and health capacities (Kwok, 2016). As Stephen and Downing (2001) argue, assessments need to be context specific. Therefore, understanding the needs of end-users and the context in which the indicators and variables are identified is essential if the results of risk models are of utility to them.

2.3.2 Applicability of benchmarking resilience indicators for communities (BRIC) in New Zealand

The second study, "Measuring community resilience: Translation of BRIC indicators to the New Zealand context" (Appendix 6), evaluated whether resilience indictors and variables from the benchmarking resilience indicators for communities (BRIC), a U.S.-based resilience assessment tool, could be applied within the New Zealand context. It examined the availability and utility of existing data sources in New Zealand that could serve as proxy resilience variables (Kwok, 2016b). The report identified several key challenges in translating indicator variables for use in New Zealand. First, given the differences in the political and institutional realities between the U.S. and New Zealand, many of the BRIC indicators and variables need to be modified for the New Zealand context. This challenge was also highlighted in a study by Singh-Peterson, Salmon, Goode, and Gallina (2014) in applying BRIC to Australia's Gold Coast. There is a need for replacement indicators and variables that reflect the realities of New Zealand's governance structures, social and community norms and institutions, as well as physical infrastructure and environmental conditions. A second challenge the author of this study found was that the geographic scales of available datasets are not consistent, with some datasets available at the smallest government data collection unit (i.e., meshblock), while others utilising only the national unit (Kwok, 2016b). The applicability of BRIC to measuring neighbourhood-level disaster resilience using aggregated meshblock-level data could present significant challenges, as data available at this geographic level are predominately collected through the New Zealand census, which constrains what data points are collected. Last, as mentioned in Section 2.2.1., disaster resilience in the BRIC resilience assessment – a quantitative assessment – is defined by outside experts. Their definition might not reflect how the concept is defined by local people. Thus, the relevance of quantitative assessments such as BRIC to local DRR priorities needs to be questioned.

While direct translation of the indicators is not appropriate in this particular setting, the disaster resilience of place (DROP) theoretical framework, which underpins BRIC concepts and indicators, provides a theoretically sound framing of disaster resilience: communities have inherent capacities that enable them to address their vulnerabilities to natural hazards. Therefore, in order to measure community resilience levels that reflect local contexts, Kwok (2016b) argues the need for understanding neighbourhood-level capacities that could contribute to their disaster resilience.

2.3.3 Social capital as a key assessment dimension

A key assessment dimension identified in these two studies is social capital - a concept that has received significant attention in disaster research and in policy settings as a way to increase disaster

resilience of individuals and communities (Aldrich & Meyer, 2014; City and County of San Francisco, 2016a; Murphy, 2007; Vallance, 2011a; Wellington City Council, 2017). Past disasters such as the Kobe earthquake in Japan, Hurricane Katrina in the U.S. Gulf Coast, Hurricane Sandy in the eastern U.S., and the Christchurch earthquakes in New Zealand have underscored the importance of social capital in facilitating community disaster and recovery (Aldrich, 2012b; Elliott, Haney, & Sams-Abiodun, 2010; Nakagawa & Shaw, 2004; Paton et al., 2014; The Associated Press-NORC Center for Public Affairs Research, 2014).

While social capital is vital to individual and community disaster resilience, research has also shown that not everyone possesses the same level of and benefits equally from social capital resources. For instance, Elliott et al. (2010) found that low-income individuals were less capable than their wealthier counterparts in activating their social networks during Hurricane Katrina, thus hindering their preparedness efforts and delaying their return to their neighbourhoods post-disaster. Furthermore, the amount of social capital benefits that individuals and groups receive also hinges upon whether they are part of a powerful social network. For example, those who belong to social networks with financial and political clouts have been shown to receive significantly more post-disaster resources from government sources and to successfully pushback undesirable post-disaster recovery interventions to the detriment of those with few connections to strong social networks and financial resources, such as low-income individuals and those who have traditionally be marginalised (e.g., women) (Aldrich, 2011a; Aldrich & Crook, 2008; Ganapati, 2013). Ganapati (2013) also found that even if women who belong to strong social networks were marginalised and rendered powerlessness by people they interact with (e.g., government officials) due to gender-based stereotypes.

Because social capital resources can be both beneficial and detrimental to the resilience of individuals and communities, the measurement of social capital needs to be able to decipher whether existing neighbourhood-based resilience activities promote or hinder the ability of local communities from effectively building and exercising their social capital resources. Thus, engaging communities in the development of social capital measures is an essential first step in fostering their resilience.

Chapter 7 presents a methodological approach for engaging local stakeholders in the development of a social capital measurement framework.

2.3.4 Concluding remarks on background research

This section provides a rationale for assessing disaster resilience by understanding not only community characteristics and capacities but also community vulnerabilities, as well as examining the different perspectives of stakeholders (end users) who will be using the assessment tool. As this thesis is focused on assessing the disaster resilience of communities the next section discusses definitional issues of the term 'community' and existing tools that are used to assess neighbourhood-level resilience.

2.4 Neighbourhood-based assessment tools: Relevance to disaster risk reduction

Even though there are many resilience assessments, more work is still needed in assessing community disaster resilience. Many resilience assessments claim to measure community disaster resilience, but how *community* is defined varies from one assessment to another. For instance, a review of community resilience assessments by Ostadtaghizadeh, Ardalan, Paton, Jabbari, and Khankeh (2015) defined community as "every geographical-based population living in urban or rural areas including villages, neighbourhoods, towns, districts, regions or a part of a mega city" (p. 3). Obviously, the scope of this definition is quite broad. This section clarifies the terms 'community' and 'neighbourhood', provides evidence for the need to assess resilience at the neighbourhood level, and discusses existing tools that are applicable to measuring neighbourhood-level resilience.

2.4.1 Definitions: Communities and neighbourhoods

Within the context of disaster management, Marsh and Buckle (2001) assert that the word 'community' has been misused in a "sweeping fashion" with the assumption that a community encompasses like-minded residents living in harmony and fails to recognise the diverse characteristics and viewpoints that exist among them (p. 5). This traditional notion of 'community' as a "geographically confined locality" where people live in close proximity is only one of the many ways in which community has been defined by researchers (e.g., Sherrieb, Norris, & Galea, 2010; Smith & Wenger, 2004, p. 246). Others refer to community as groups of people who share common perspectives, identities, or relational ties (e.g., MacQueen et al., 2001). Because of potential conceptual confusion, this thesis makes a distinction between community and neighbourhood. The term *community* is used to describe a group (or a collection of groups) with shared similarities, and the term *neighbourhood* refers to the study's unit of analysis. For this thesis, neighbourhood is defined as "the bundle of spatially-based attributes associated with clusters of residences,

sometimes in conjunction with other land uses" (Galster, 2001, p. 2112). Neighbourhoods are spatially bounded units in which characteristics pertaining to demographics, social interactions, physical features, environmental conditions, public services, politics, and sentiments and perspectives can be examined (Galster, 2001). This thesis views a neighbourhood as comprising diverse communities, and this diversity contributes to the need for understanding the different perspectives in informing the development of neighbourhood-based disaster resilience measures.

2.4.2 Neighbourhoods as units of analysis in disaster research

The focus on neighbourhoods as a geographical context in social science research goes back decades. Neighbourhood-based studies have sought to understand how neighbourhood characteristics influence individual and group outcomes, perceptions, and behaviours, such as social networks (Ellen & Turner, 1997), crime and neighbourhood disorders (Franzini et al., 2008; Sampson, Raudenbush, & Earls, 1997) and public health (Kawachi & Berkman, 2003). In disaster research, investigations into neighbourhood-level conditions have focused on the underlying causes of differential disaster impacts experienced by people and communities.

Differences in disaster outcomes have long been attributed to socioeconomic factors (O'Keefe, Westgate, & Wisner, 1976), with poorer people and groups deemed less capable of taking preventative actions before, and to recover after, disasters (Finch, Emrich, & Cutter, 2010; Tierney & Oliver-Smith, 2012; Wisner et al., 2004). These observations, especially after major disasters in recent years, have spawned extensive research on place-based socioeconomic vulnerabilities of people and communities (e.g., Cutter, 1996) and the development of social vulnerability indices and assessments (e.g., Cutter, Carolina, Boruff, & Shirley, 2003; Noriega & Ludwig, 2012; Walker et al., 2014). Disaster researchers have also sought to examine the conditions and processes that differentiate the speed and quality of disaster response and recovery between neighbourhoods (e.g., Boon, 2013; Chamlee-Wright & Storr, 2010; Graham, Debucquoy, & Anguelovski, 2016; Paton et al., 2014; Storr & Haeffele-Balch, 2012; The Associated Press-NORC Center for Public Affairs Research, 2014).

Within the context of disaster research, neighbourhoods provide opportunities for the examination of place-based processes and conditions that facilitate or impede the development of community disaster resilience. As a unit of analysis, a neighbourhood is "locus par excellence of 'informal governance'", which refers to its ability to maintain social order, arrive at collective decisions, perform public services, and aggregate and articulate public sentiments even though it does not have any formal government authority (Crenson, 1983; Lelieveldt, 2008, p. 331). When neighbourhoods are temporarily cut off from official public services after a hazard event, the

observed differential outcomes of informal governance in different neighbourhoods provides fertile ground for the examination of underlying contributing factors and impediments to resilience, so that appropriate localised DRR interventions can be developed and implemented.

2.4.3 Neighbourhoods as the focus of disaster risk reduction (DRR) interventions

With a growing recognition by the disaster management sector that local communities are the frontline of disaster preparedness and response (Gaillard & Mercer, 2013), local policies and programmes are being developed to not only reduce vulnerabilities but also enhance disaster readiness capacities (e.g., skills, knowledge, and resources) of neighbourhoods. Since community-based initiatives often target specific geographical areas (e.g., planning jurisdictions or service areas), whose boundaries are defined by government or non-profit agencies (Coulton, Cook, & Irwin, 2004), many local-level DRR interventions have focused at the neighbourhood level, including the neighbourhood-based resilience building initiative, Ready Neighborhoods, in the San Francisco Bay Area region. Additional examples of neighbourhood-based resilience programmes can be found across urban and rural communities (City and County of San Francisco, 2016a; Eisenman, Adams, & Rivard, 2016; IFRC, 2007, 2015; Neighborhood Empowerment Network, 2014; Plough et al., 2013; WREMO, 2012). As the City and County of San Francisco asserts, the focus on neighbourhood-based resilience interventions is rooted in the belief that existing neighbourhood-level networks can be effective partners to disaster management organisations in meeting the needs of vulnerable residents and neighbourhood institutions, cultivating peer-to-peer engagement in the adoption of resilience behaviours, and offering pathways for building local capacities (City and County of San Francisco, 2016b).

As discussed in Chapter 1, the Wellington and San Francisco regions have adopted resilience policies that focus DRR efforts in neighbourhoods as part of their strategies to achieving city- and region-wide resilience. In the Wellington region, the WREMO's community resilience strategy seeks to increase neighbourhood-based disaster resilience through localised engagement and preparedness activities as follows:

- Recruit and expand volunteer programme to support disaster management activities
- Facilitate the creation of neighbourhood-based community response plans
- Improve disaster readiness of social services agencies to support vulnerable residents
- Improve readiness of disaster response planning for primary and secondary schools
- Support the growth of neighbourhood support groups and other community organisations that bring people together
- Increase readiness of small- to medium-sized businesses through business continuity planning

- Facilitate community-driven activities that build resilience capacity, increase connectedness and foster cooperation among individuals, organisations and communities (WREMO, 2012)

In San Francisco, the primary coordinating agency for neighbourhood-based DRR interventions is the government-funded Neighborhood Empowerment Network (NEN), which is an alliance of residents, neighbourhood and merchant associations, non-profits and faith-based organisations, foundations and academic institutions that seek to build neighbourhood resilience to a wide range of hazards (City and County of San Francisco, 2018b). Through its Empowered Communities Program (ECP), NEN works to "move ownership of community resilience down to the neighborhood level" by building the leadership capacities of local residents (City and County of San Francisco, 2016b, p. 4). As a leadership development programme, ECP's primary objective is to train existing and emergent neighbourhood leaders to assist with the development of neighbourhood-based Resilience Action Plans, which are place-based strategies for building each community's ideal resilient condition (City and County of San Francisco, 2016b). Each Resilience Action Plan contains the following:

- Neighbourhood goals and objectives for building the resilience at the individual, organisational, and community levels
- A risk and hazard assessment that combines expert and local knowledge
- A neighbourhood governance framework to help guide local decision-making processes in a disaster

These two programmes in Wellington and San Francisco seek to decentralise DRR activities from local governments to communities through increasing the knowledge and capacity of neighbourhood stakeholders and organisations. While these examples point to the need for encouraging local ownership of DRR, assessing the efficacy of these programmes remains a challenge. If neighbourhood-based DRR initiatives are tasked with strengthening neighbourhood capacities, then it is essential to baseline and track levels of neighbourhood resilience to ensure that resilience interventions are effective.

2.4.4 Neighbourhood-based disaster resilience assessment tools

There are numerous resilience assessment tools, and Table 2.4 presents a distillation of selected tools that are designed or can be used to assess neighbourhood-level resilience. The tools are selected from the works of Cutter (2016), Ostadtaghizadeh et al. (2015), and Pfefferbaum et al. (2015), as well as from the broader literature. While this list is not exhaustive, it demonstrates the growing interest in research and in practice to develop assessment tools at this geographic level. Each assessment tool is categorised by its type and key resilience dimensions are assessed.

Table 2.4 *Selected assessments for neighbourhood-level resilience*

Tool	Type of assessment	Key dimensions assessed
9 Minimum Characteristics of Disaster-resilient Communities in Nepal (Flagship 4, 2012)	Quantitative	Organisational base; access to DRR information; multi-hazard risks and assessments; community preparedness/response teams; DRR plan; access to community-managed resources; local level risk/vulnerability reduction measures; and community-based early warning system
CART (Pfefferbaum et al., 2011)	Quantitative	Connection and caring; resources; transformative potential; and disaster management
CCRAM (Cohen, 2013)	Quantitative	Leadership; collective efficacy; preparedness; place attachment; social trust; and social relationship
Coastal Community Resilience Assessment (U.S. Indian Ocean Tsunami Warning System Program, 2007)	Quantitative/ Participatory*	Governance; society and economy; coastal resource management; land use and structural design; risk knowledge; warning and evacuation; emergency response; and disaster recovery
Coastal Resilience Index (Sempier, Swann, Emmer, Sempier, & Schneider, 2010)	Quantitative	Critical infrastructure and facilities; transportation issues; community plans and agreements; mitigation measures; business plans; and social systems
Community Resilience Manual – Canadian Centre for Community Renewal (Colussi, 2000)	Quantitative/ Participatory	People; organisations; resources; and community process
Community Resilience Toolkit – Bay Localize (Bay Localize, 2009)	Quantitative/ Participatory	Food; water; energy; transportation and housing; jobs and economy; and civic services
Community Resilient System (CARRI, 2013; White, Edwards, Farrar, & Plodinec, 2014)	Quantitative/ Participatory	Community identity; critical threats; and community capabilities; critical assets; and recovery resources for community services areas
Community-based resilience analysis (CoBRA) (United Nations Development Programme, 2014b)	Quantitative/ Participatory	Financial; human; natural; physical; and social
Los Angeles County Community Disaster Resilience Project (LACCDR) index (Eisenman et al., 2016)	Quantitative	Community engagement, emergency supplies, communication with neighbours, civic engagement, and collective efficacy
NIST (National Institute of Standards and Technology, 2015)	Quantitative	Financial; built; political; social; human; cultural; and natural
Resilience to Emergencies and Disasters Index (REDI) (Kontokosta & Malik, 2018)	Quantitative	Social infrastructure and community connectivity; physical infrastructure; economic strength; and environmental conditions
Rural Resilience Index (Cox & Hamlen, 2014)	Quantitative/ Participatory	Social fabric; community resources; and disaster management
SPUR (Poland, 2009)	Quantitative	Critical response facilities and support systems; emergency housing and support systems; housing and neighbourhood infrastructure; and community recovery
Torrens Resilience Institute's (TRI) community and household scorecards (Arbon et al., 2016)	Quantitative	Community connectedness, risk and vulnerability, planning and procedures, available resources
Urban resilience measurement tools: Urban Disaster Risk Index (UDRi), Risk Management Index (RMI), and Disaster Resilience Index (DRI) (Khazai et al., 2015)	Quantitative/ Participatory	UDRi: Physical risk; social fragility; and lack of resilience RMI: Policies on risk identification; risk mitigation; disaster management; and financial protection DRI: Legal and institutional; awareness and capacity building; critical services, infrastructures, and resiliency; development planning,

		regulation and risk mitigation; and emergency preparedness, response and recovery planning
Vulnerability and Capacity Assessment (IFRC, 2007)	Participatory	Natural, physical, financial, human, and social

*Quantitative/Participatory: Assessment measures are quantitative that are derived from participatory methods. Generally, rather than having a rigid set of quantitative indicators, proposed measures serve as guidance for local stakeholders.

A common thread among these neighbourhood-based resilience assessments is the identification of factors that are descriptive of neighbourhood characteristics, including social systems and processes. They seek to assess existing levels of neighbourhood capacities with the goal of developing or enhancing the necessary capacities for resilience.

2.4.5 Limitations of existing neighbourhood-based resilience assessments

While the community development perspective is rooted in neighbourhood-based resilience assessments, several issues have been identified. First, many factors are difficult to operationalise (e.g., transformative potential, health and wellbeing) and are not easily influenced or amenable to change by neighbourhood-based resilience interventions. These include specific quantitative variables (e.g., levels of education, income, and homeownership) that are used in many existing resilience assessments, as they can only be achieved through adjustments in broader societal policies (Gaillard & Mercer, 2013).

Second, the predominant use of quantitative approaches to assess neighbourhood disaster resilience presents only a snapshot of existing neighbourhood conditions and neglects the examination of underlying influences that have shaped those conditions such as people's attitudes, values, and beliefs of themselves and their environment (Paton, Mamula-Seadon, et al., 2013).

Recent research in resilience assessments has pointed to the need for evaluating resilience using a grounded approach (e.g., Freitag et al., 2014; Khazai et al., 2015; National Institute of Standards and Technology, 2015). It seeks to elicit from neighbourhood stakeholders an in-depth understanding of local conditions and dynamics that foster a neighbourhood's readiness and response capacity. It has been argued that engaging local stakeholders to assess their community's exposure to hazards, assets and capacities as part of the DRR planning process promotes local ownership and improvements in disaster preparedness, response, and recovery (Berke, Cooper, Salvesen, Spurlock, & Rausch, 2011; Horney, Nguyen, Salvesen, Tomasco, & Berke, 2016; Pfefferbaum, Neas, et al., 2013). Although it is encouraging that emergency management practitioners and non-governmental

agencies involved in disaster risk reduction (DRR) planning have increasingly engaged local stakeholders in soliciting their expertise and experiences on risk reduction strategies (City and County of San Francisco, 2016b; Gaillard & Mercer, 2013; Shaw, 2012; WREMO, 2012), community participation has yet to be fully integrated in DRR planning at the local level (LaLone, 2012; Montgomery, 2013; Pearce, 2003; Schmeltz et al., 2013). One reason is that local knowledge has been challenged by government and non-governmental agencies as being non-scientific (Mercer, 2012). Unfortunately, many national DRR policies continue to value scientific knowledge over local perspectives in designing and implementing risk reduction strategies (Gaillard & Mercer, 2013; IFRC, 2010). Because experts have more sway in policy and programme development circles as their knowledge is considered more scientific and credible (Gaillard & Mercer, 2013), an unintended consequence is that experts are disempowering the very people and communities that these assessments and interventions seek to help.

This problem especially rings true in the development of resilience benchmarking and evaluation tools. For instance, of the 36 selected community resilience assessment tools reviewed by Sharifi (2016), only 36% of them used a participatory approach in their development process, while the rest were formulated through the use of literature and opinions of external experts. Potential differences in priorities between outside experts and local stakeholders can create a disconnect between government policies and local needs (IFRC, 2016). One example of a disconnect was observed in government-led preparedness efforts. Prior to the landfall of Hurricane Katrina, many African-American residents ignored government's evacuation orders for reasons that included inconsistent messages, perceived racism in government preparedness responses and local authority, and lack of financial resources to evacuate (Elder et al., 2007). Another example is the reconstruction process post-Christchurch earthquake. Vallance (2011a) found that government agencies were more focused on technical solutions of reconstruction than taking into account how their solutions might affect the livelihoods of residents, which resulted in maladaptive recovery interventions and an erosion of residents' trust of their government. Challenges such as these could potentially cost lives, result in inefficient use of resources, create political uncertainty, and stall recovery (Elder et al., 2007; Vallance, 2014).

As Scolobig et al. (2015) assert, a gap remains between the rhetoric and reality of community-based and people-centred disaster management planning. As seen in Table 2.4, few neighbourhood-based resilience measurement tools were participatory in their development process and implementation. These issues call into question the utility of top-down tools for neighbourhood-based resilience assessment. If disaster management officials want local stakeholders to take ownership of disaster planning and enhance post-disaster recovery process, then they must better understand residents'

perspectives on their needs and priorities and engage them in the planning process (Scolobig et al., 2015; Vallance, 2014).

2.5 Future directions for research: Co-producing resilience measures through integrating expert and local knowledge

Overall, a fundamental issue to any resilience assessment development and implementation is addressing for whom the assessments are developed. This issue concerns whether assessments should be created for policymakers and planners at the regional or local jurisdictions, or for households and neighbourhoods that will be responsible for disaster preparedness and response. The latter case draws attention to the importance of including an assessment approach that is grounded in the neighbourhood – where the diversity of needs and priorities is greatest – and is integrated into local and regional resilience planning frameworks.

As DRR policies increasingly advocate for empowering communities in the sharing of responsibilities between governments and communities (2009 Victorian Bushfires Royal Commission, 2010; Committee on Increasing National Resilience, 2012; UNISDR, 2015b), it is essential to develop measures that are genuinely neighbourhood-based and amenable to change through community development, engagement, and empowerment programmes. Substantial progress is needed to engage local communities in the development of resilience assessments that can provide a holistic view of hazard risks, community vulnerabilities, and community capacities (Gaillard & Mercer, 2013). As argued by von Schirnding (2002), assessments informed by neighbourhood stakeholders "can be more useful for community-based monitoring of locally relevant issues than national or global indicators in which the link with local activities is often remote" (p. 23).

Developing such an understanding can best be accomplished by ascertaining the views of community members about what they think contributes to their resilience. It is essential to assess not only the 'what' in resilience (i.e., structural conditions), but also the 'why' in resilience (i.e., cognitive influences). To address the structural and cognitive dimensions of disaster resilience, resilience measures need to reflect the experiences and perspectives of neighbourhood stakeholders.

Thus, the use of a bottom-up, participatory approach from the beginning of DRR planning provides future opportunities for building community capacities (e.g. decision-making processes), increasing people's trust toward decision-makers, enhancing buy-in for the implementation phase of DRR interventions, empowering residents, identifying novel solutions to specific neighbourhood

problems, improving planning outcomes, and expediting recovery processes (Cox & Hamlen, 2014; Dekens, 2007; Horney, Nguyen, et al., 2016; Pfefferbaum et al., 2015; Pfefferbaum, Reissman, Pfefferbaum, Klomp, & Gurwitch, 2007; Vallance, 2014). The integration of local perspectives with those from the scientific and expert communities allows for the development of interventions that are tailored to local needs and accommodate the unique ways in which different neighbourhoods deal with natural hazard events. Such an approach entails defining what resilience means for different stakeholders, as well as measuring and developing resilience in multiple ways, bringing about the potential for effective DRR assessments, planning, and interventions (Davies et al., 2015; Gaillard & Mercer, 2013).

Therefore, this thesis adopts Gaillard and Mercer's (2013) road map for integrating local knowledge to identify neighbourhood-level resilience measures (Figure 2.2).

Figure 2.2 A road map for integrating knowledge, actions and stakeholders for DRR. Reprinted from "From knowledge to action: Bridging gaps in disaster risk reduction", by J. C. Gaillar and J. Mercer, 2013, *Progress in Human Geography, 37*(1), p. 95.

This road map outlines the horizontal process for assessing risks and developing DRR actions. It combines top-down and bottom-up approaches by integrating scientific (or expert) and local knowledge from a wide array of stakeholders operating outside and within communities. Adopting this process, this thesis develops a neighbourhood-level resilience framework and a set of assessment measures around social resilience by integrating different forms of knowledge and perspectives that includes researchers, policymakers, practitioners, and individuals who live and work in the neighbourhoods. It is the goal of this thesis to provide a foundation for embedding resilience benchmarking and evaluation measures into subsequent neighbourhood-based resilience

development strategies, thus increasing the likelihood that local interventions will be more reflective of local needs and priorities.

The next chapter discusses the methodology and methods used to solicit and integrate different perspectives on community disaster resilience and, with a focus on social resilience, how these perspectives contribute to the development of neighbourhood-based resilience measures.

Chapter 3 – Methodology

3.1 Introduction

Chapter 2 presents the various conceptualisations of disaster resilience, the typologies of assessments that have sought to operationalise the concept, and the key dimensions measured by those assessments. It also describes several gaps in existing assessments in regard to adequately addressing the values, needs, and priorities essential to baselining neighbourhood disaster resilience levels. Specifically, few assessment tools take into account both structural and cognitive dimensions of resilience, or integrate the diverse perspectives of experts and neighbourhood stakeholders.

3.2 Research question and aims

Existing conceptualisations of resilience span various societal dimensions and scales, but this thesis investigated the social dimension of resilience at the neighbourhood level. To address existing gaps in the literature on baselining neighbourhood disaster resilience, the primary question of this thesis was as follows:

How can social resilience to disasters be measured at the neighbourhood level?

To answer this overarching research question, this research addressed several sub-questions:

- How is disaster resilience currently being conceptualised and measured in the literature?
- What is social resilience? How is social resilience defined by different stakeholder groups that include researchers, policymakers, practitioners, and neighbourhood stakeholders?
- Based on the perspectives of diverse stakeholder groups, what are the common features and characteristics of social resilience?
- How do underlying contextual influences shape the perspectives of social resilience?
- What assessment measures can be identified to reflect the diverse perspectives and common features of social resilience?

The aims of this research are to derive a measurement framework and a set of measures for assessing neighbourhood-level social resilience.

3.3 Sequence of research projects

To answer the primary research question and sub-questions, this thesis consists of two sequential research projects. The first project consisted of a structured workshop with experts that comprised

hazards researchers, emergency management practitioners, and policymakers. This was followed by the second project that involved a series of focus groups with neighbourhood stakeholders. The completion of the first project provided the foundation and justification for the second project. Figure 1 illustrates the sequential process and timeline of this thesis's research activities.

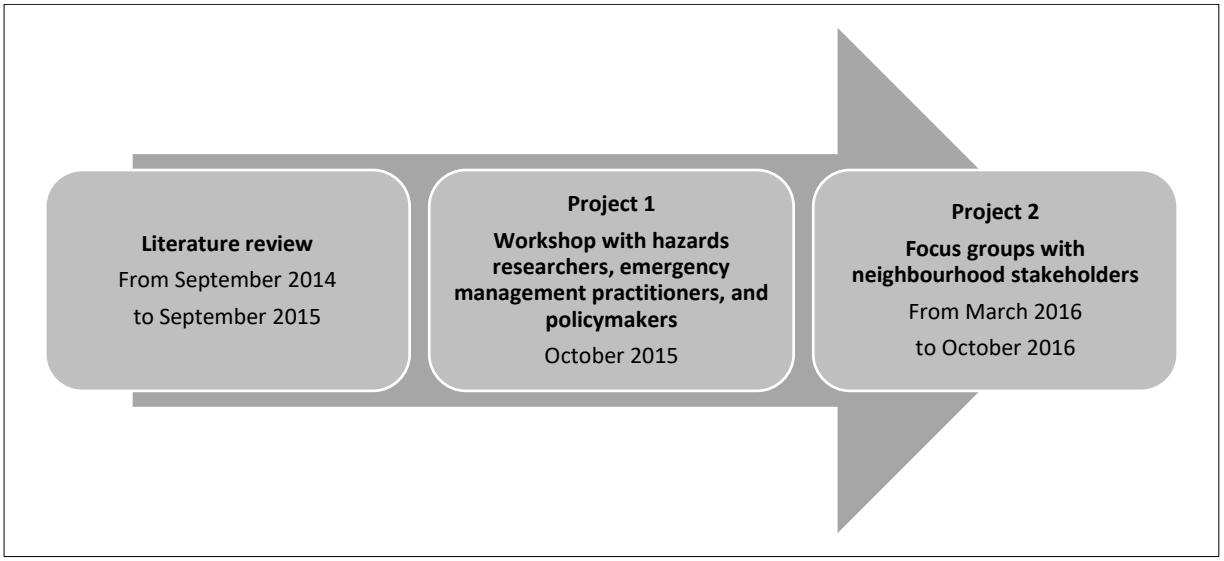


Figure 3.1 Sequence of research activities.

Each part of the research sequence was designed to answer specific research sub-questions. Table 3.1 outlines the thesis's sub-questions and the corresponding projects and research outputs.

Table 3.1 *Research questions and projects*

Overarching research question		
How can social resilience to disasters be measured at the neighbourhood level?		
Research sub-question	**Project**	**Output**
1. *How is disaster resilience currently being conceptualised and measured in the literature?*	Literature review of resilience concepts and measurement approaches	Chapter 2: Literature review GNS science reports in Appendices 5 and 6
2. *What is social resilience? How is social resilience defined by different stakeholder groups that include researchers, policymakers, practitioners, and neighbourhood stakeholders?*	Workshop with experts Neighbourhood-based focus groups	Manuscript: *What is 'social resilience'? Perspectives of disaster researchers, emergency management practitioners, and policymakers in New Zealand*, Chapter 5
3. *Based on the perspectives of these stakeholder groups, what are the common features and characteristics of social resilience?*	Workshop with experts Neighbourhood-based focus groups	Manuscript: *A bottom-up approach to developing a neighbourhood-based resilience measurement framework*, Chapter 6
4. *How do underlying contextual influences shape the*	Neighbourhood-based focus groups	Manuscript: *A bottom-up approach to developing a neighbourhood-based*

perspectives of social resilience? 5. *What assessment measures can be identified to reflect the diverse perspectives and common features of social resilience?*		*resilience measurement framework*, Chapter 7 Manuscript: *Stakeholders' perspectives of social capital in informing the development of neighbourhood-based disaster resilience measurements*, Chapter 7

The literature review provided a snapshot of existing indicators and variables that are currently in use to measure disaster resilience (sub-question 1) and served as a foundation for designing the research projects that included a structured workshop and a series of neighbourhood focus groups. The first project sought to define and identify the attributes of social resilience through a structured workshop attended by hazards researchers, policymakers, and practitioners from the Wellington region (sub-question 2).

Workshop participants explored key social resilience factors and strategies that would facilitate the development of or enhance these attributes in neighbourhoods (sub-questions 3 and 4). The workshop findings are presented as a published manuscript (Kwok et al., 2016) and included in Chapter 5. The second project of the thesis engaged neighbourhood stakeholders to understand their perspectives on disaster resilience (sub-question 2). Specifically, focus group discussions addressed questions relating to factors that contribute to neighbourhood social resilience (sub-questions 3, 4, and 5). Findings of the focus groups are presented in two manuscripts – one published (Kwok, Paton, Becker, Hudson-Doyle, & Johnston, 2018) and one submitted to a peer review journal (Kwok, Becker, Paton, Hudson-Doyle, & Johnston, 2018) – that are attached as Chapters 6 and 7.

3.4. Research approach

To answer the primary research question and sub-questions and to achieve the aims of developing a measurement framework and associated measures for assessing neighbourhood-level social resilience, a qualitative approach was used.

As discussed in Chapter 2, many of the existing neighbourhood-based resilience assessments are rooted in quantitative methods that reduce disaster resilience to a score, rank, or other form of numerical calculation. While assessment results based on this approach provide a broad snapshot of resilience levels that can be compared across geography, this reductionist approach overlooks the diversity of capacities, values, beliefs, needs, and priorities that exists in communities. While there

are advantages and disadvantages to each approach, the use of qualitative approaches allows for in-depth descriptions that reflect community-based interactions and diverse perspectives.

3.5 Research methodology

As this thesis seeks to embrace diverse perspectives on disaster resilience through a participatory approach and is focused on application and implementation of disaster resilience measures, the researcher used a type of action research methodology called appreciative inquiry methodology. This section first describes what action research is, then it outlines the appreciative inquiry approach to data collection.

3.5.1 Action research

By definition, action research is carried out by a researcher in collaboration with members of a community or a network in an effort to resolve complex, everyday problems (Greenwood & Levin, 2007). Because the goal is to address local issues, action research is rooted in a participatory approach to research, whereby the involvement of diverse stakeholders is central to the development of practical solutions that lead to equitable and sustainable outcomes (Greenwood & Levin, 2007; Reason & Bradbury, 2001)

Researchers undertaking action research place an emphasis on people's knowledge and their understanding of issues facing their communities. Therefore, they place research and solutions to real-life problems at the local level by focusing on the construction of people's experiences and meanings (Greenwood & Levin, 2007). Instead of seeing knowledge as objective and value-free, action researchers recognise that research is embedded in people's systems of values and interactions and the socially constructed nature of knowledge (Brydon-Miller, Greenwood, & Maguire, 2003). Furthermore, they see people's experiences as shaped by processes beyond their agency, and takes a holistic view of the world where human actions are intertwined with the larger societal system that undergoes a continual process of change (Greenwood & Levin, 2007). Hence, inquiry and action in action research are combined in a dynamic process that evolves as new ways of thinking and doing things emerge (Greenwood & Levin, 2007).

The core characteristics of action research include the following:

- Action research is context-bound and addresses real-life problems holistically
- Action research is an inquiry process whereby participants and researchers cogenerate knowledge and the participants' contributions are taken seriously

- Action research embraces the diversity of experiences and capacities within local groups as enriching the research-action process
- The meanings constructed in the inquiry process lead to social action, or reflections on action lead to the construction of new meanings
- The validity of action research knowledge is measured by the ability of actions to solve problems and increase participants' control over their own situations (Greenwood & Levin, 2007, p. 63).

3.5.2 Appreciative inquiry

While there are many types of action research, this thesis adopts appreciative inquiry as a methodological approach. Appreciative inquiry (AI) is a form of action research that embraces the idea that social life and structures are constructed through relational interactions (Zandee & Cooperrider, 2008). Originally theorised by David Cooperrider of Case Western Reserve University, AI seeks to challenge researchers to see the "complex, messy, and emergent nature" of human experiences and the world as full of possibilities and to refrain from "reductionist thinking in either/or (positive/negative) dichotomies" (Zandee & Cooperrider, 2008, pg. 191 and 192). It is an asset-based and forward-looking paradigm that combines "research and action, inquiry and intervention" by engaging participants in a social transformation process of thinking about what is possible (Zandee & Cooperrider, 2008, p. 193). AI keeps the inquiry process open, and accepts that truth is "multi-faceted and impermanent" (Zandee & Cooperrider, 2008, p. 196).

Two recurring themes – inclusivity and the focus on the positive – are reflected in research studies that are guided by AI principles (Reed, 2011). First, AI's inclusivity principle aims to draw on the experiences of individuals who can contribute to the research process but are not traditionally included in studies. This inclusivity challenges the discipline's status quo and also makes impactful changes in participants' communities (Zandee & Cooperrider, 2008). AI researchers embrace large group conversations, as they see individual experiences arise through interactions between people (Zandee & Cooperrider, 2008). The inclusivity principle is directly related to action research, where people's participation in the research process is paramount (Greenwood & Levin, 2007).

Second, appreciative inquiry intentionally explores the positive aspects of a research topic by examining successes and achievements in the area under study (Reed, 2011). This approach advocates for a line of inquiry that builds on people's experiences of achievements rather than failures, since such an approach is believed to empower participants by creating opportunities for them to imagine and integrate successes into their action plans (Reed, 2011). It is important to note that AI does not discount failures or negative views during the inquiry process, as the methodology recognises the inherent value of these perspectives in contributing to the understanding of a

research topic. Rather, AI contends that participants are more likely to become change agents if the research process starts off and continues positively (Reed, 2011).

As a methodological approach, AI sits squarely within the qualitative paradigm of research. Instead of testing hypotheses, AI examines the topic of research through open and exploratory questions, with an aim of discovering perspectives and values of everyday life (Watkins, Mohar, & Kelly, 2011). While there are no prescribed methods associated with this methodology, AI theorists and practitioners have pointed to four general phases of AI research. The '4-D' framework, as it is known, refers to discovery, dreaming, designing, and delivery (Reed, 2011; Watkins et al., 2011):

1. The *discovery* phase invites participants to discuss what gives life to a particular setting or issue. Participants explore, or appreciate, the positive aspects of their surroundings or the topic. It focuses on the exploration of moments when people and groups have functioned optimally and the underlying structures, dynamics and other conditions that allowed those moments to flourish (Watkins et al., 2011).
2. In the *dreaming* phase, participants envision possibilities for the future that encompasses the positive aspects of their environment to rise. Participants are challenged to think creatively (Watkins et al., 2011). This phase is synonymous to brainstorming sessions, where the free-flowing of ideas, without concerns for existing constraints, is promoted (Reed, 2011).
3. The third phase, *design*, provides participants with an opportunity to craft plans for the future. It seeks to create possible social infrastructures (e.g. organisational structures and skills) and identify the desired qualities necessary to fulfil their plans (Watkins et al., 2011).
4. The last phase is *delivery*, which connects participants' appreciations, visions, and plans into actionable and sustainable activities (Reed, 2011; Watkins et al., 2011). This phase is on-going, requiring participants to periodically revisit stated objectives and activities in the previous phases and adjust them based on lessons learned, new ideas, and available resources (Watkins et al., 2011).

Given the scope of the research topic, this thesis focuses on the first two phases of appreciative inquiry – discovery and dreaming – as they relate to development of a disaster resilience assessment framework and measures.

With the adoption of AI as a methodological approach, this research employed two different types or participatory data collection methods: a workshop with experts and focus groups with neighbourhood stakeholders. The chosen data collection methods of the structured workshop and focus groups were consistent with the principles of appreciative inquiry, in which the invitation to

participate in this research was decided based on whether participants' experience and knowledge could be of value to the research (Reed, 2011).

This research was judged to be low risk under Massey human ethics guidelines. Low-risk human ethics notifications for the structured workshop and the focus groups were lodged with the Massey University Human Ethics committee (Appendices 7 and 8).

3.6 Structured workshop – Rationale

The first research project used a workshop format to solicit the perspectives of experts from the Wellington region to identify essential characteristics that contribute to the social resilience of communities. Simply put, a workshop is a gathering of a group of people to learn and discuss a topic at length for a given purpose in a structured format (Stanfield, 2002). The workshop format was chosen because of its ability to facilitate the exchange of ideas among stakeholders in the research, policy, and practice communities from the Wellington region, as well as to provide the researcher with an opportunity to solicit a wide range of perspectives within a short amount of time.

The timing of the structured workshop in 2015 coincided with a confluence of city, regional, and national disaster resilience planning efforts in New Zealand. At the city and regional levels and as described in Chapter 1, these efforts included the community resilience strategy by WREMO to develop neighbourhood-specific disaster response plans (WREMO, 2012); the region's selection as part of the 100 Resilient Cities initiative (The Rockefeller Foundation, 2015); and the region's designation as the International Centre of Excellence in Community Resilience (ICoE:CR) by the United Nations' Integrated Research and Disaster Risk (IRDR) programme (International Centre of Excellence in Community Resilience, 2014). In particular, the ICoE:CR seeks to characterise resilience based on an understanding of how community and cultural processes influence resilience (International Centre of Excellence in Community Resilience, 2014). This thesis contributes to the fulfilment of this objective.

In addition to these city- and region-level efforts, national resilience efforts included the Ministry of Business Innovation and Employment's decade-long programme, Resilience to Nature's Challenges. This programme involves a cross-section of government entities and research organisations creating research solutions to challenges facing New Zealand's "rapidly changing cultural, economic, built, and natural environments" (Ministry of Business Innovation and Employment, 2016). The Ministry of Civil Defence and Emergency Management also began a stakeholder engagement process with civil defence groups, relevant government agencies and research entities, and the private sector to develop a national resilience strategy as part of its commitment to the international Sendai

Framework (Ministry of Civil Defence and Emergency Management, 2018). These efforts created an opportunity for this research project to be 'plugged in' to the fledging research and planning efforts at that time.

While the researcher would have liked to conduct a similar workshop with experts in San Francisco, two constrains prevented this. First, the cost of travel between Wellington and San Francisco proved prohibitive. Second, the researcher had concerns about convening government and non-government stakeholders in San Francisco at that time, when government and non-government stakeholders had already convened to develop its resilience strategy as part of the 100RC initiative. Although the topic of this research project is directly related to the resilience strategy, the timing of this research project was deemed inappropriate for that location. Focus groups, however, were conducted in San Francisco. The next section discusses the rationale for using focus groups as a data collection method.

3.7 Focus groups – Rationale

Following the workshop with experts, nine focus groups were conducted with stakeholders across three neighbourhoods in San Francisco and two in the Wellington region. Details of the demographics of neighbourhoods and focus group participants are presented in Chapter 4. The focus groups sought to explore the contextual factors and assumptions underlying how community disaster resilience is defined from neighbourhood stakeholders' perspectives. The goal of the focus groups was to understand neighbourhood-based factors, values, and beliefs that could inform the development of a resilience assessment framework, and the identification of measures that reflect local needs and priorities.

In qualitative research, focus groups are a form of interview style – either through guided or unguided discussions – designed for small groups (Berg, 2004). The aim of focus groups is to explore and clarify people's views on a topic of interest to the group and the researcher (Edmunds, 1999). This method seeks to draw out participants' beliefs and attitudes and aid in the examination of what they think, how they think, and why they think the way they do (Kitzinger, 1995).

Data collected through focus groups reflect both the interaction between participants, in which they are encouraged to relate with each other by asking questions, exchanging their views, and commenting on the perspectives of other participants, and between participants and the focus group facilitator or researcher (Kitzinger, 1995; Morgan, 1996; Wilkinson, 1998). This method acknowledges the active role the researcher plays in the data collection process (Morgan, 1996).

As this thesis's primary objective is to assess the perspectives of disaster resilience at the neighbourhood level, data collected from focus groups are *group data*, which "reflect the collective notions shared and negotiated by the group" (Berg, 2004, p. 138). Interactions between participants provide insights into how they constructed meanings around shared experiences and shared ways of making sense of the research topic (Wilkinson, 1998). The use of the focus group method fits with the research objective by examining how community resilience is interpreted as a collective experience.

Focus groups are also well suited for research that focuses on exploring and assessing local needs and refining assessment tools (Carey, 1994). Specifically, three key features of focus groups merit their use as a data collection method to identify resilience measures:

- Exploring participants' own meanings, language, and concepts on a topic
- Tapping into cultural values and group norms of participants
- Empowering participants in the research process

The first feature of the focus group method was particularly useful for understanding how neighbourhood stakeholders define community disaster resilience and identify social resilience characteristics. Instead of imposing the researcher's language and ideologies on participants' conversations, participants used their own language to convey their views (Wilkinson, 1998). Focus group participants also discussed, in their own vernacular, the social problems confronting their communities, barriers to people's behavioural changes, and existing community strengths (Murray, Tapson, Turnbull, Mccallum, & Little, 1994).

The second feature of the focus groups was the relatively natural conversations between focus groups participants, which also revealed important insights into existing cultural values and groups norms that underpinned their views and experiences (Kitzinger, 1995; Wilkinson, 1998). To be discussed in Chapter 7, underlying cultural and group values and beliefs through anecdotes were conveyed. Such insights allowed for the examination of how cultural and normative factors have influenced participants' perceptions and behaviours (Kitzinger, 1995).

Third, unlike one-on-one interviews, whereby the researcher dictates the agenda of the process, focus groups provide a more egalitarian approach to researching (Wilkinson, 1998). By virtue of the number of participants simultaneously engaged in the research process, the focus group method reduces the researcher's power and places participants on a more equal footing with each other and with the facilitator (Berg, 2004; Wilkinson, 1998). As this action research sought to empower participants in this participatory research process, the focus group method allowed participants an

avenue for defining realities within a group context and interpreting the topic of discussion that reflected group input (Frey & Fontana, 1991). Furthermore, this method provided participants with a greater authority to set the direction of the research discussions that reflected priorities and lines of thinking that were most salient to them (Wilkinson, 1998).

3.8 Linking to Chapter 4 – Research Methods

This chapter describes the questions and aims of this research and the sequence of activities undertaken that addressed the thesis's questions. It also provides a rationale for the research approach and methodology. The next chapter (Chapter 4) describes in detail the methods used for each research project: structured workshop and focus groups.

Chapter 4 – Research methods

4.1 Introduction

The last chapter discusses the methodology of this research. This chapter details the research methods used for both the structured workshop and focus groups, specifically procedures relating to participant recruitment, facilitation or moderation, and data analysis. Section 4.2. discusses workshop methods and Section 4.3. discusses focus group methods. In Section 4.4., data analysis methods used for both the structured workshop and focus groups are outlined.

4.2 Research methods – Structured workshop

The first project of this thesis was a workshop with experts comprising hazard researchers, emergency management practitioners, and policymakers. The primary objective of this research was to examine how the participants conceptualise social resilience and to identify its key conceptual dimensions. The secondary objective was to formulate strategies to develop the social resilience of communities.

4.2.1 Participant recruitment

The Wellington region is home to the International Centre of Excellence in Community Resilience (ICoE:CR), and workshop participants were recruited through the ICoE:CR database (International Centre of Excellence in Community Resilience, 2014). A workshop invitation email was sent to database subscribers. Thirteen participants attended the workshop. Of those who participated, there were six academic researchers, six emergency management practitioners, and one policymaker from the government.

4.2.2 Workshop materials

Upon registering for the workshop, each participant received via email an information sheet that outlined the purpose of the workshop, workshop procedures, and participant rights (Appendix 9), as well as a participant consent form (Appendix 10). Physical copies and a verbal summary of these documents were furnished to participants at the beginning of the workshop, and participants were provided time to review them. Each participant signed the informed consent form. Each participant also received a workshop agenda (Appendix 11).

4.2.3 Workshop facilitation

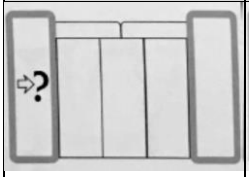
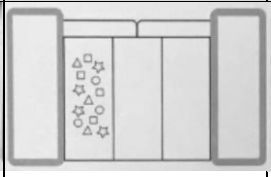
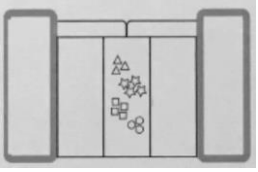
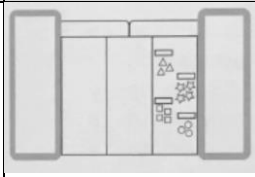
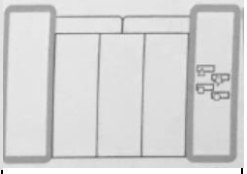
The workshop was facilitated by the researcher using the Technology of Participation (ToP) facilitation methods. ToP is a set of facilitation and participatory group techniques developed by the Institute of Cultural Affairs to fulfil the following objectives:

- Recognise and honour contributions of all
- Let a group deal with more data in less time
- Pool individual contributions into larger, more informative and inclusive patterns
- Welcome diversity while minimising polarisation and conflict (The Institute of Cultural Affairs, 2000, p. i).

This facilitation method was chosen for its alignment with the underlying principles of appreciative inquiry and action research. First, ToP's facilitation process steers away from a top-down approach to problem-solving toward a bottom-up process that shifts decision-making to group participants. By acknowledging that knowledge and expertise are embedded in the interactions between people, the ToP approach embraces the group's diversity of opinions, builds on the creativity and capabilities of group members, and provides tools for decision-making and action planning that are owned and implemented by them (The Institute of Cultural Affairs, 2000). The facilitation techniques seek to reach consensus in a short amount of time through a sequential collective thinking process and aims to ensure that all participants feel that their contributions are heard and their ideas are integrated into the results of the workshop (The Institute of Cultural Affairs, 2000).

The ToP facilitation method comprises five sequential steps, as illustrated in Figure 4.1:

Figure 4.1 Consensus workshop stages and purposes. Adapted from *ToP facilitation methods: Effective methods for participation*, by The Institute of Cultural Affairs, 2000.

Context	**Brainstorm**	**Cluster**	**Name**	**Resolve**
				
Set the stage	Generate new ideas	Form new relationships	Discern the consensus	Confirm the resolve

1. *Provide context*: This step sets the stage for the workshop. It states the purpose or objectives of the workshop, outlines the workshop process, and leads group members to discuss the topic(s) using focused conversation.
2. *Brainstorm*: This step seeks to generate opinions and ideas by having participants individually write down their responses to workshop questions.

3. *Cluster*: This process involves workshop participants grouping similar responses. The initial clustering of responses occurs in sub-groups. Each sub-group presents four to six of their responses to the rest of the workshop members, and any similar presented answers are clustered at the group level. Following this process, sub-group members present to the entire group any remaining responses that are different from those that have been presented. This process of clustering and sharing ensures that all perspectives are recognised by workshop participants.
4. *Name*: Once all the responses are consolidated, participants name or create a title for each cluster (or single response) that answers the workshop question. The naming process starts with the largest cluster of similar responses and is repeated for the other clusters.
5. *Resolve*: All names are read aloud and adjusted if needed by participants. This process ensures that each named cluster accurately reflects participants' responses. The workshop facilitator then leads participants in a process of discussing the significance of names and elicits further discussions to address any remaining concerns and questions.

By adopting these facilitation steps, the workshop consisted of four activities, lasting two and a half hours. The first activity set the stage for understanding social resilience by asking workshop participants to define community resilience. Workshop participants completed the statement, "A resilient community is/has…" by writing out one- to three-word responses. This exercise served to 'warm-up' participants for the next three core activity segments. The second activity narrowed the focus of the workshop by asking participants to define and discuss the attributes of social resilience. The third activity had participants explore the temporal importance of social resilience attributes on the different phases of a disaster – reduction, readiness, response, and recovery, or the '4Rs' (The 4Rs correspond with the mitigation, preparedness, response, and recovery phases of a disaster (Section 1.3). Definitions of reduction, readiness, response, and recovery are presented in Section 5.2.4). In the final activity, participants identified existing and potential actions that would cultivate and enhance the previously identified social resilience attributes (Figure 4.2). Each of the three participant types – researcher, practitioner, and policymaker – was asked to write down existing programmes, policies, and ideas. Chapter 5 outlines these four activities in depth.

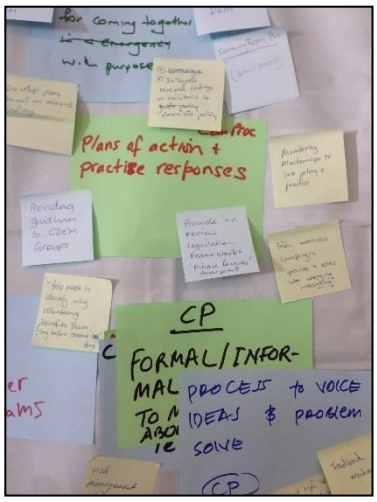


Figure 4.2 Identification of existing and potential community resilience-enhancing activities. Author's photo, 2015.

4.3 Research methods – Focus groups

Following the workshop with experts, focus groups of neighbourhood stakeholders were conducted to explore the contextual factors and assumptions underlying how community disaster resilience is defined from their perspectives. The goal of the focus groups was to understand neighbourhood-based factors, values, and beliefs that could inform both the development of a resilience assessment framework and the identification of measures that reflect local needs and priorities.

4.3.1 Selection of neighbourhoods

As past research has shown, differential levels of vulnerabilities and resilience between communities are associated with different socioeconomic status and ethnic make-up (Finch et al., 2010). Therefore, government datasets were used as a starting point to identify potential neighbourhoods that represent varying degrees of socioeconomic levels and ethnic compositions. Since comparable datasets do not exist between these two regions, this research used different sources of data to narrow the list of potential neighbourhoods. Neighbourhoods in the Wellington region were screened by the New Zealand Social Deprivation Index (NZDep) – a composite of socioeconomic variables that measure deprivation of small geographic areas across New Zealand on a continuous score, with a mean of 1,000 index points (Atkinson, Salmond, & Crampton, 2014). For neighbourhoods in San Francisco, census data on household income and racial makeup was used (San Francisco Planning Department, 2012; U.S. Census Bureau, 2014).

The researcher then shortlisted the number of neighbourhoods in each region by consulting with local emergency management practitioners. Key neighbourhood stakeholders, or gatekeepers, were involved to determine the suitability of their neighbourhoods as study sites. This consultation

process resulted in the selection of two neighbourhoods in the Wellington region (Figure 4.3) – Brooklyn in Wellington City and Cannons Creek in Porirua City (Figure 4.4) – and three within San Francisco (Figure 4.5) – Miraloma Park, Bayview, and Chinatown (Figures 4.6).

Figure 4.3 Wellington region, including Wellington city and Porirua city (denoted by ★). Retrieved from https://www.openstreetmap.org. Copyright (2017) by OpenStreetMap contributors.

a. Brooklyn, Wellington city

b. Cannons Creek, Porirua city

Figure 4.4 Study sites in the Wellington region: (a) Brooklyn and (b) Cannons Creek (denoted by ★). Retrieved from https://www.openstreetmap.org. Copyright (2017) by OpenStreetMap contributors.

Figure 4.5 San Francisco region, including City and County of San Francisco (denoted by ★). Retrieved from https://www.openstreetmap.org. Copyright (2017) by OpenStreetMap contributors.

Figure 4.6 Study sites in San Francisco: Miraloma Park, Bayview, and Chinatown (denoted by ★). Retrieved from https://www.openstreetmap.org. Copyright (2017) by OpenStreetMap contributors.

Demographic summary of neighbourhoods in the Wellington and San Francisco regions are listed in Table 4.1.

Table 4.1 *Demographics of study neighbourhoods*

Location	**Pop.**	**NZDep Score**	**Median HH Income (NZD)**	**Ethnicity* (top three)**		
Wellington Region	471,315	973	$74,300	European (73.2%)	Māori (12.4%)	Asian (10.0%)
Brooklyn	6,504	939	$102,200	European (78.7%)	Asian (11.3%)	Māori (6.5%)
Cannons Creek						
East	3,594	1200	$47,100	Pasifika (65.5%)	European (17.9%)	Māori (17.6%)
South	1,533	1186	$47,200	Pasifika (60.3%)	European (23.9%)	Māori (23.9%)

North	3,132	1238	$38,900	Pasifika (54.0%)	European (23.7%)	Māori (23.3%)
Location	**Pop.**	**% Pop Below Poverty Level**	**Median HH Income (USD)**	**Race and Ethnicity** (top three)**		
City and County of San Francisco	829,092	13.3%	$78,378	White (41.4%)	Asian (33.3%)	Latino (15.3%)
Miraloma Park	4,849	6%	$121,151	White (57.6%)	Asian (25.2%)	Latino (9.8%)
Bayview	35,201	23.5%	$49,594	Asian (32.9%)	Black (32.8%)	Latino (21.7%)
Chinatown	9,998	32%	$18,368	Asian (80.9%)	White (12.36%)	Latino (3.7%)

Note. From atlas.id (2013), San Francisco Planning Department (2012), and U.S. Census Bureau (2014).
*New Zealand's Statistics New Zealand (2016a) defines ethnicity as a measure of cultural affiliation (as opposed to race, ancestry, nationality or citizenship), which includes a shared a common geographic origin and/or a shared sense of common origins or ancestry. A European refers to a person having origins from various nations in Europe. Māori are the indigenous people of New Zealand. Pasifika refers to Pacific peoples in New Zealand. An Asian is a person with origins from various nations in Asia.
**The U.S. Census Bureau's (2018b) racial categories reflect a social definition of race that is recognised in the United States and is not an attempt to define race biologically, anthropologically, or genetically. A White person is someone having origins in any of the original peoples of Europe, the Middle East, or North Africa. A Black (or African-American) person is someone having origins in any of the Black racial groups of Africa. An Asian is a person having origins in any of the original peoples of the Far East, Southeast Asia, or the Indian subcontinent. The Census Bureau's (2018a) ethnic category defines Latino (or Latina) as a person of Cuban, Mexican, Puerto Rican, South or Central American, or other Spanish culture or origin regardless of race.

4.3.2 Participants' recruitment

This thesis uses purposive sampling methods to identify a mix of focus group participants. Participants either lived or worked full-time in a study site and were at least 18 years of age. To solicit diverse perspectives on the research topic, focus group participants were recruited based on whether they had prior emergency management training or planning experience. Such experiences included participation in a community response planning session organised by WREMO (in Wellington) or by NEN (in San Francisco); training sessions conducted by NERT (in San Francisco) or by the Red Cross; or other voluntary or paid experience within the emergency management sector. Such experiences have been attributed to increase the levels of resilience (Godschalk, 2003). The author of this thesis also believed that recruiting participants without such experiences might provide more representative perspectives on community resilience. Thus, participants with and without emergency management experiences were recruited.

Nine focus groups with 58 participants were conducted between March 2016 and October 2016. Participant recruitment was conducted through government agency representatives, community-based organisations, community leaders, flyers posted in neighbourhoods, and social media postings. Selected characteristics of focus group participants and recruitment methods are summarised in Table 4.2. Each participant received a retail gift card as a token of appreciation at the end of the focus group.

Table 4.2 *Participants' background, gender, and recruitment methods, by neighbourhood*

Neighbourhood	No. of focus groups	EM Experience		Status*		Recruitment method(s)
		With EM training/ planning	*Without* EM training/ planning	Resident	Worker/ Employee	
Brooklyn (NZ)	2	9	6	15	3	Government agency, flyers, social media
Cannons Creek (NZ)	2	1	11	10	7	CBO representatives, flyers
Miraloma Park (US)	1	8	0	8	1	Community leader
Bayview (US)	3	6	8	12	2	Government agency, CBOs, flyers
Chinatown (US)	1	4	5	0**	8	CBO representatives
Total	9	28	30			

*Some participants live and work full-time in the community and are listed in both columns.
**A participant in the Chinatown focus group is a non-resident client of a community-based agency.

4.3.3 Procedures for focus groups

Each focus group session lasted for approximately one and a half hours and was digitally audio-recorded. The researcher of this thesis served as the facilitator for the focus groups and developed a script to guide their process (Appendix 12). Each session consisted of four segments as recommended by Berg (2004): introduction, statement of guidelines, question-and-answer discussions, and follow-up remarks. Each of these segments is discussed in detail next.

4.3.3.1 Introduction

The purpose of this segment was to establish trust and ensure that research participants understood their role in the research (Berg, 2004; Carey, 1994). At the beginning of each focus group, the researcher introduced himself and provided participants with a basic description of the research study. Each participant received an information sheet, which outlined the purpose of the research study, focus group format and procedures, and participant's rights and privacy issues (Appendix 13).

4.3.3.2 Statement of guidelines

To cultivate an environment where discussions are truthful, the researcher presented a set of ground rules around interactions between participants. These rights and ground rules reiterated best practices in conducting focus groups and protecting the privacy of participants so they could freely share their opinions without the fear of being exposed (Berg, 2004; Carey, 1994; Creswell, 2007). Participants' rights are listed in Table 4.3 and ground rules are listed in Table 4.4.

Table 4.3 *Rights of focus group participants*

Participants can:
• Decline to answer any particular question • Withdraw from the study at any time before the results are sent for publication • Ask any questions about the study at any time during participation • Provide information on the understanding that their name will not be used unless they give permission to the researcher • Ask for the audio recording to be turned off at any time during the group discussion • Be given access to a summary of the project findings when it is concluded

Table 4.4 *Ground rules for focus groups*

Rules were printed on A3 paper in large print and were verbally presented.
• We want you to do the talking • There are no right or wrong answers … say what you want (you have the right to pass) • What is said in this room stays here to ensure confidentiality

Participants were given time to ask questions and request clarification on any procedures or guidelines. All participants agreed to participate in the research study and either signed a consent form (Appendix 14) or verbally consented to participation.

4.3.3.3 Question-and-answer discussions

Once participants understood and agreed to participate, the researcher began with an introductory question to help participants become acquainted with each other (Berg, 2004). Participants shared their names, occupations, whether they live or work in the neighbourhood, and their length of tenure or employment in the neighbourhood. Next, the researcher used several techniques to solicit both the explicit and implicit views of participants. Mirroring the procedures used in the structured workshop, each participant was asked to write (and for those who did not want to write, to draw or think silently) his or her responses to the initial set of questions before sharing them with the group (i.e., *How would you describe your neighbourhood? When you hear the phrase 'community resilience', what do you think of?*) (also refer to Appendix 12). This format helped the researcher to assess what each participant knew individually without being influenced by others in the group (Berg, 2004; Frey & Fontana, 1991).

The researcher used a technique called 'probing' to explore the underlying assumptions and contextual influences that have shaped participants' perspectives (Carey, 1994; Krueger & Casey, 2000). This technique seeks to encourage participants to share more details by following up their responses with questions such as "Tell me a little me more", "Why did you say that?", "What made you feel that way?", and "Why do you think this important?". These probing questions seek to make implicit values, beliefs, and attitudes explicit.

4.3.3.4 Follow-up remarks

After the question-and-answer discussions, the researcher concluded each focus group with a closing question: “Is there anything else you would like to add?” or a variation of it. This question provided participants with an opportunity to share additional comments (Krueger & Casey, 2000). Further concluding remarks included a reminder to participants of their right to contact the researcher should they have additional comments. No comments were received.

Consistent with the principles of action research, the researcher requested focus group participants to verify the accuracy of the transcriptions and findings presented in drafted manuscripts. The researcher did not receive any comments that altered the results of the findings, and the stakeholder checks enhanced the reliability of research findings by engaging participants in the data verification process (Thomas, 2006).

4.4 Data Analysis

Data from the workshop and focus groups were analysed using two complementary data analysis methods: general inductive approach and thematic analysis. The first method, general inductive approach, helps researchers analyse data to meet assessment objectives (Thomas, 2006). It can be used to summarise extensive and varied text data for the purpose of assessment and evaluation, and contribute to the development of a framework about the underlying structure of experiences or processes identified in the data. As outlined by Thomas (2006), the general inductive approach involves the identification of themes or categories, which could be used for determining appropriate assessment measures. Under the method the development of themes was guided by the focus (or domains) of the research questions and thesis’s objectives (Thomas, 2006). For instance, themes related to the various conceptualisations of community disaster resilience as described in the literature review (Chapter 2). The general inductive approach aligns with the aim of the thesis, which is to develop an assessment framework consisting of key themes and measures for the purpose of baselining disaster resilience level of neighbourhoods and informing the evaluation of subsequent resilience interventions.

The second approach to data analysis was thematic analysis (Braun & Clarke, 2006). Simply defined, thematic analysis is “a method for identifying, analysing, and reporting patterns (themes) within data” (Braun & Clarke, 2006, p. 79). The integration of thematic analysis in the general inductive approach ensured a more robust set of procedures for data analysis. For instance, the general inductive approach focuses more on identifying discrete themes or categories for assessment and

evaluation purposes. It seeks to answer the 'what is' questions in evaluation (e.g., What should be measured? How many themes should be included in the measurement tool?) (Thomas, 2006). Thematic analysis provides better procedural grounding for answering the 'why' questions through its emphasis on exploring underlying beliefs, values, and assumptions behind those themes (Braun & Clarke, 2006).

Data analysis procedures under the general inductive approach and thematic analysis are comparable. Both approaches emphasise the importance of becoming familiar with the data through multiple readings, identifying text segments for coding and creating themes, and combining and reviewing similar themes and sub-themes. The general inductive approach provides additional, specific guidance on preparing the raw data and coding. For example, Thomas (2006) prescribes procedures for data cleaning (e.g., formatting raw data files in a common format) and dealing with overlapping coding. For thematic analysis, Braun and Clark (2006) assert the need for social researchers to produce a scholarly report through "the selection of vivid, compelling extract examples" that relate back to the research question and literature review (p. 87). This thesis integrates these two approaches to data analysis, resulting in seven data analysis phases, which are listed in Table 4.5.

Table 4.4 *Phases of data analysis adopted for this thesis, as compared to phases of the general inductive approach and thematic analysis*

Phases adopted for this thesis	**Phases of the general inductive approach** (Thomas, 2006)	**Phases of thematic analysis** (Braun & Clarke, 2006)
1. Data preparation	1. Preparation of raw data files (data cleaning)	
2. Familiarising with the data through multiple readings	2. Close reading of text	1. Familiarising with the data
3. Generating initial codes	3. Creation of categories or themes 4. Overlapping coding and uncoded text	2. Generating initial codes
4. Identifying themes and sub-themes		3. Searching for themes
5. Reviewing themes	5. Continuing revision and refinement of category or theme system	4. Reviewing themes
6. Labelling and describing themes		5. Defining and naming themes
7. Presenting relevant themes	6. Creating a framework incorporating the most important categories	6. Producing the report

4.4.1 Coding and theme generation

At the heart of data analysis is coding raw text data and identifying themes. The author used NVivo (version 11) to code and identify themes in the transcriptions of the structured workshop and focus groups.

A code refers to “the most basic segment, or element, of the raw data or information that can be assessed in a meaningful way regarding the phenomenon” (Boyatzis, 1998, p. 63). In other words, it is a feature of a piece of data that is of interest to the study (Braun & Clarke, 2006). There are two approaches to coding. The first is more data-driven, seeking to code data without trying to fit it into the researcher’s analytic preconceptions. The second is theory-driven, in which the coding process is based on pre-existing theoretical perspectives. A theory-driven thematic analysis provides a focus to how themes are developed, so that they are identified based on particular features in the dataset (Braun & Clarke, 2006). This thesis uses a combination of data-driven and theory-driven approaches in which codes were derived from the data themselves, as well as informed by existing theories pertaining to disaster resilience in the literature.

Once the codes were identified, themes were developed. A theme represents an important patterned response or meaning within the data. Thomas (2006) refers to a pattern as a theme if it appears frequently, is dominant, or is otherwise significant (Thomas, 2006). Braun and Clarke (2006) present a more precise criterion for a theme, “prevalence”, which refers to the extent to which a response occurs within a data item or across the entire dataset (p. 82). Prevalence can be quantifiable by enumerating the frequency of a code within a dataset or across datasets. Boyatzis (1998), for instance, asserts that themes can be transformed into a quantitative form for statistical analysis. Themes from the structured workshop, for instance, were counted by their frequency (Chapter 5). However, prevalence need not be quantifiable. In the analysis of focus group data, themes were identified according to their “keyness”, which means to what degree they capture an important aspect of the research as it relates to the research questions (Braun & Clarke, 2006, p. 82).

4.4.2 Data analysis: Workshop

The workshop activities described in Section 4.2.3. resulted in three sets of data: Individual responses to workshop activity questions, group responses, and discussions (transcribed) between members of each group and between groups. These three datasets were thematically analysed. First, each individual response was coded into social resilience attribute(s). Second, once all the attributes were aggregated, they were refined and cross-validated using the transcribed discussions. Last, overarching thematic attributes and sub-attributes were developed based upon the responses of participants as well as themes and theories from the literature. This recursive process of coding and theme development ensured an accurate reflection of workshop participants’ priorities and insights.

Chapter 5 describes in further detail the codes and themes produced as a result of the workshop activities.

4.4.3 Data analysis: Focus groups

Focus group data were analysed using the data analysis approach outlined in Table 4.6. This section discusses each phase in detail.

Table 4.6 *Focus group data analysis phases*

1. Data preparation
2. Familiarising with the data through multiple readings
3. Generating initial codes
4. Identifying themes and sub-themes
5. Reviewing themes
6. Labelling and describing themes
7. Presenting relevant themes

Note. From Braun and Clarke (2006) and Thomas (2006).

4.4.3.1 Data preparation

The first step of data preparation was a manual transcription of voice recordings in NVivo. Recordings of all focus group verbal discussions were transcribed verbatim. Transcriptions also included verbal utterances that were contextual to the meanings of the discussions. A standardised format was adopted for all focus group transcriptions. Table 4.7 lists the letters or symbols used in the transcription process. To protect the anonymity of participants, each participant was assigned an alphanumeric character. A participant from a Bayview focus group, for example, would be designated as B1.

Table 4.7 *Transcription format and keys*

Identification and formatting	Key
Facilitator	F
Participant	First letter of neighbourhood name, followed by a number (e.g., B1). In transcripts that were sent out to participants, the number was redacted.
Identifiable information	…
Indecipherable words or phrases	---
Emotions	(laugh)
Participant(s) interruption or jumping in the discussions	Indent, followed by participant alpha-numeric identifier
Multiple participants (indecipherable) interrupting	B---/B---
Comments or notes by facilitator for clarification	[ ]

A focus group conversation excerpt that reflects this transcription process is presented as follows:

> F [Facilitator]: *So if there's a, say a natural disaster or some event happens in Cannons Creek, how do you think Cannons Creek will deal with it?*

C7: *We've had one. And we had a storm really bad one time, and the power got cut, and we had people coming knock on our doors, asking if everyone's okay. Pulling trees from, people's --- were on the old road.*

C1: *Lucky you, I've got nobody. (laughs)*

C7: *And just helping each other.*

C4: *They'd go to the marae.*

4.4.3.2 Familiarising with the data through multiple readings

Focus group recordings and their respective transcripts were reviewed two or more times. The researcher emailed a copy of redacted transcription (i.e., transcription without any identifiable information, including participants' designated alphanumeric characters) to focus group participants for verification. Participants could only review the transcription that pertained to the focus group they attended. None of the participants made any requests for revisions.

4.4.3.3 Generating initial codes

Codes were developed based on focus group transcripts. During the coding process, codes were reviewed and text segments recoded as appropriate. Table 4.8 provides examples of coded participants' responses.

Table 4.8 *Coding of participants' responses*

Question	Data extract	Coded segment	Code
What does your neighbourhood need (i.e., skills, abilities, knowledge, resources, values and beliefs, and community processes) in order to anticipate, cope with, and overcome the challenges and changes from a disaster, such as an earthquake?	*So I think the education piece, I think there still remains to be a lot done. But I think in terms of, like, I think at least for the first 72 hours, you are going to be on your own, right? You are going to have people --- I think people here, still know their neighbours. They might not get along with their neighbours, but at least they know their neighbours.*	*I think the education piece, I think there still remain to be a lot done.*	Need for preparedness education
		But I think in terms of, like, I think at least for the first 72 hours, you are going to be on your own, right?	Need for individual preparedness
			Understanding of disaster consequences
		I think people here, still know their neighbours, they might not get along with their neighbours, but at least they know their neighbours.	Importance of social networks

4.4.3.4 Identifying themes and sub-themes and reviewing themes

Once the transcripts were coded, the codes were collated and organised into themes or sub-themes. This step involves combining, refining, separating, and discarding codes as they relate to a broader sub-theme, which in turn links to an even broader theme (Braun & Clarke, 2006). Each theme was reviewed to ensure that it related to the corresponding codes and extracts and captured the

"contours" of the coded data (Braun & Clarke, 2006, p. 91). Through this review process, each theme was found to be supported by a set of subthemes or codes, resulting in four levels of codes or themes. Table 4.9 illustrates the four levels of themes, sub-themes, and codes identified in the focus group data.

Table 4.9 *Four levels of coding of focus group transcripts*

Level 1	**Level 2**	**Level 3**	**Level 4**
Theme	**Sub-theme/code**	**Sub-theme/code**	**Code**
Example: *Community space and amenities*	*Community place*	*Centralised location*	
		Functions of a community space	*A place for dialogue, debate, and planning*
			Community events

The list of consolidated themes, sub-themes, and codes from the focus group transcripts is included in Appendix 15.

4.4.3.5 Labelling and describing themes

Labelling and describing pertains to identifying the "essence" of each theme as it relates to the data codes and sub-themes (Braun & Clarke, 2006, p. 92). Since thematic analysis is a reflexive process (Braun & Clarke, 2006), some of the themes identified in the previous steps were renamed or further separated as part of the process of finalising a resilience measurement framework. Short descriptions of themes used in the proposed assessment frameworks are presented in subsequent chapters.

4.5 Results

Research results are presented in a series of published and submitted manuscripts, which are attached to this thesis as Chapters 5–7 (Kwok et al., 2016; Kwok, Becker, et al., 2018; Kwok, Paton, et al., 2018). While this research focused on earthquake hazards, research participants in both the structured workshop and focus groups discussed a range of natural and human-made hazards (e.g., flooding, fire, crime) when they talked about the concept of community disaster resilience. Therefore, the papers in this thesis, while focused on earthquakes, also include other types of hazards.

4.6 Link to Chapter 5 – Paper 1

The following chapter (Chapter 5 – Paper 1, Kwok et al., 2016) examines the cognitive and structural dimensions of social resilience as conceptualised by stakeholders who are considered to be experts: hazards researchers, emergency management practitioners, and policymakers. As part of research

project #1 (refer to Section 3.3), a workshop comprising of experts was held in Wellington, New Zealand. The next chapter presents results from the workshop. Particularly, it presents and discusses key factors that are essential to social resilience of communities. Based on these factors, a measurement framework is proposed for assessing social resilience, and outlines strategies and actions for increasing neighbourhood-level resilience.

Chapter 5 – Paper 1: What is 'social resilience'? Perspectives of disaster researchers, emergency management practitioners, and policymakers in New Zealand

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Abstract

There is an increasing need to evaluate the underlying drivers of disaster resilience. Much of the existing research on resilience measurements assesses factors pertaining to a spectrum of societal domains that includes social, economic, institutional, infrastructural, and natural environments. Research has focused on the importance of social resilience – the capacity of people and communities to deal with external stresses and shocks – and how it contributes to community preparedness, disaster response, and post-disaster recovery. As a component of disaster resilience, social resilience has been examined by researchers across a multitude of academic disciplines. As a result, there are tremendous variations in how this concept is assessed. To better understand what social resilience means, this research examined the perspectives of hazards researchers, emergency management practitioners, and policymakers from New Zealand's Wellington region. The results of their responses revealed similarities in how social resilience is perceived across these three sectors. Overall, the most frequently mentioned social resilience attributes are *community gathering place*, followed by *social support*, *knowledge of risks and consequences*, *collective efficacy*, and *sense of community*. Through synthesising their responses and the literature, a core set of social resilience indicators is proposed.

5.1 Introduction

Disasters of the past decade have drawn considerable attention to the need to build resilient communities. The Sendai Framework for Disaster Risk Reduction 2015–2030 calls for the reduction of disaster risks through an "all-of-society" and "all-of-State institutions" engagement approach that emphasises the important role that local governments and communities play in reducing vulnerabilities and enhancing community resilience (UNISDR, 2015b, p. 5). As local communities begin to translate national and sub-national disaster resilience policies into practice, there is a growing need to identify the factors that affect community vulnerabilities and resilience. These factors have formed the basis of the emerging field of research in disaster resilience measurements, as they enable governments and local stakeholders to identify resilience gaps and evaluate progress and investment strategies (Committee on Increasing National Resilience, 2012).

Existing attempts by governments and the scientific community to understand what factors contribute to disaster resilience have resulted in a divergence of resilience indicators, with many of them focused on social, economic, physical, natural and/or institutional systems and conditions (Cutter, 2016; Ostadtaghizadeh et al., 2015). As a component of disaster resilience, the social resilience of groups and communities has gained the attention of researchers across a multitude of academic disciplines. Yet the scale of analysis for much of the existing assessments has focused on the city level or higher. As research increasingly focuses on the importance of social resilience and how it contributes to community preparedness, disaster response, and post-disaster recovery (e.g., Aldrich & Meyer, 2014; Paton et al., 2014; Paton, Mamula-Seadon, et al., 2013), it remains to be seen whether these indicators are relevant and applicable at the sub-city or neighbourhood level (Cutter, 2016).

In order to ascribe social resilience factors and to develop a set of indicators that are applicable at the neighbourhood level, this research examined the perspectives of hazards researchers, emergency management practitioners, and policymakers from New Zealand's Wellington region.

5.2 Literature on community and social resilience measurements

5.2.1 Measuring community disaster resilience

Resilience measures seek to evaluate a society's capacity to adapt to challenges before and after a disaster (Paton & Johnston, 2006). Despite an increasing number of resilience measurement tools and models, there are tremendous variations in how resilience is assessed and what is being measured (Cutter, 2016; Ostadtaghizadeh et al., 2015). For instance, methodological approaches to

resilience measurements can be categorised as either idiographic (bottom-up) or nomothetic (top-down) (Cutter, 2016). Bottom-up approaches result in place-specific measures that tend to be derived through qualitative data collection methods, while top-down approaches enable comparison across various units of analysis through the use of large quantitative datasets (Cutter, 2016). In addition, there are challenges in operationalising and measuring this concept. A systematic review of resilience models and tools by Ostadtaghizadeh et al. (2015) found that out of the 675 papers that referenced 'community resilience,' only 17 actually attempted to measure community resilience. In those papers, the review found inconsistent classification of resilience domains and definitions of concepts. Particularly, the variety of conceptualisations of resilience domains and indicators underscores the multifaceted and complex nature of resilience.

Despite these differences, resilience measurements generally fall into the following resilience domains: social, economic, institutional, built, and natural environments (Cutter et al., 2010). Some resilience models also differentiate indicators based on scale of analysis (e.g., individual and neighbourhood) and functions (e.g., information and communication). General consensus among researchers stresses the need to assess existing community assets, resources, and capacities (e.g., community capitals, transformative potential, adaptive capacities) at all phases of disaster management (Cutter et al., 2010; Mayunga, 2009; Norris et al., 2008; Paton & Johnston, 2006; Pfefferbaum et al., 2011).

5.2.2 Framing social resilience of communities

The resilience of the social environment – social resilience – refers to a social unit or a group to collectively cope with or respond to external stresses and disturbances resulting from social, political, and environmental changes (Adger, 2000). By adapting Cutter's (2016) framework on resilience, social resilience can be conceptualised as a process of capacity building (e.g., disaster planning), as a post-disaster outcome (e.g., rate of population retention after an earthquake), or as both a process and an outcome. Much of the existing disaster resilience measurements to date seek to either evaluate pre-existing conditions that influence activities and outcomes relating to the hazard event or post-disaster conditions. For instance, emergent research in disaster resilience assessments has focused on the concept of social resilience as it relates to influencing and predicting the recovery trajectories of people and communities (Aldrich, 2010, 2011b; Burton, 2014; Cox & Perry, 2011; Johnston et al., 2011; Paton et al., 2014; Paton, Mamula-Seadon, et al., 2013; Tatsuki, 2007).

As a socially-constructed phenomenon, disaster recovery of the social environment is a "socially-configured process" that "spans multiple entities and social sectors, multiple processes and a variety

of potential outcomes" (Tierney & Oliver-Smith, 2012, p. 124). Activities associated with social disaster recovery occur immediately following the hazard event and include sheltering disaster victims; distributing food and financial aid; providing psychosocial support; rebuilding livelihoods; and other processes that enable people to "achieve desired levels of social well-being [and health], quality of life, sense of place and belonging, and civic engagement" (Tierney & Oliver-Smith, 2012, p. 124). As such, many of the resilience evaluation tools (e.g., Cutter et al., 2010; Kafle, 2012; Morgan et al., 2015; Sherrieb et al., 2010) attempt to incorporate measures that capture these social recovery processes and outcomes and their underlying drivers.

In addition to conceptualising social resilience as a process and as an outcome, the concept is also framed by its different dimensions and scales, which are discussed next.

5.2.3 Structural and cognitive dimensions of social resilience

Existing social resilience measures reflect structural and cognitive dimensions of the social environment. Structural dimensions encompass discrete features and characteristics of a social entity such as people and communities (Uphoff, 1999) and may include elements associated with health status and demographic characteristics. Structural social resilience indicators based on Cutter et al.'s (2014) research are listed in Figure 5.1. As opposed to structural social resilience, cognitive dimensions of social resilience focus on the attitudes, values, and beliefs of individuals as well as their mental processes and perceptions of themselves and their environment (Paton, Mamula-Seadon, et al., 2013). The predictive cognitive indicators of resilience in Paton's model are listed in Figure 5.1. Finally, Buckle (2006) outlines the tangible resources and intangible qualities – both structural and cognitive – that contribute to pre- and post-disaster functions of social units at different societal levels (Table 5.1).

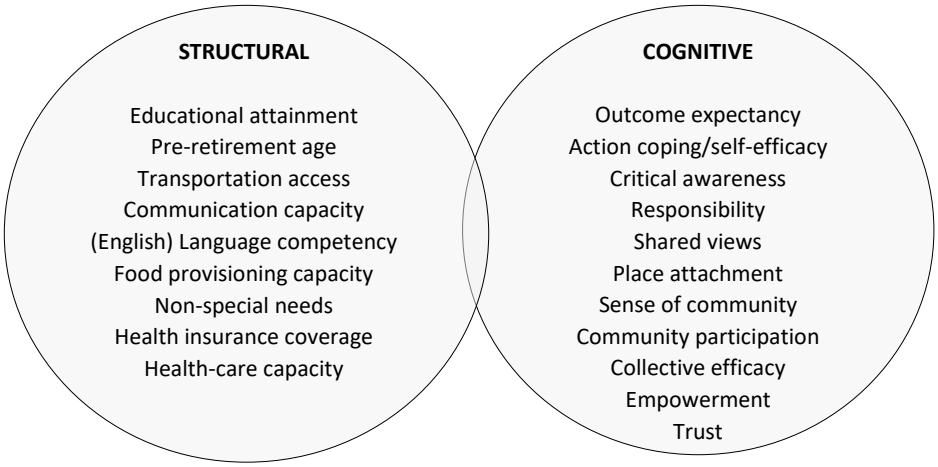

Figure 5.11 Structural and cognitive community resilience indicators in Paton's (Paton & McClure, 2013) and Cutter et al.'s (2014) models. Adapted from D. Paton and J. McClure (2013) and S. L. Cutter, K. D. Ash, and C. T. Emrich (2014).

Table 5.1 *A list of dimensions and attributes of social resilience*

Levels and Dimensions of Social Resilience

Levels of Social Resilience	Dimensions of Resilience
Individual	Mental health/well-being
Family	Home/shelter
Tribe or clan	Safety and civil security
Locality or neighbourhood	Food
Community	Potable water
Social associations such as clubs and faith congregations	Sewage and public health system
	Information about services and support
Organisation (such as a bureaucracy or a private sector firm)	Access to services and support
	Income security/economic opportunity
Systems such as environmental systems and economic systems	Social links, social networks, and social support
	Community owned assets
	Community "owned"/shared tangibles (such as values, aspirations, communal activities)

Elements Supporting Social Resilience

Individual/Group	Community
Information and advice	Knowledge of hazards
Resources	Shared community values
Management capacity	Established social infrastructure
Personal and community support	Positive social and economic trends
Involvement	Partnerships
	Resources and skills

Note. From "Assessing social resilience", by P. Buckle, 2006, Disaster Resilience: An Integrated Approach, p. 93-98.

5.2.4 Temporal dimensions of social resilience

In addition to having structural and cognitive qualities, social resilience is also temporally-bound, in that the levels of social resilience change throughout the disaster cycle (Paton, 2006b). In New Zealand, the different disaster phases are reduction, readiness, response, and recovery – or the '4Rs'

(Ministry of Civil Defence and Emergency Management, 2008). The reduction phase includes activities related to the identification of long-term hazard risks to people and properties and to the elimination and reduction of risks and disaster consequences. The readiness phase includes activities that seek to develop the operational capacity of people and institutions before a disaster happens. They may include preparedness and response activities for the public, as well as programmes that protect lifelines and other societal functions. Activities associated with the response phase are taken immediately before, during, or directly after a disaster with the goal of saving lives, protecting properties, and assisting communities to recover. During disaster recovery, the coordinated efforts and processes among people and agencies help facilitate immediate, medium-term, and long-term regeneration of communities following a disaster (Ministry of Civil Defence and Emergency Management, 2008). The 4Rs correspond with the mitigation, preparedness, response, and recovery phases of a disaster.

The relative salience of social resilience factors changes as people progress through different phases of a disaster. Maguire and Hagan (2007) explain that social resilience exhibits three temporal properties: resistance, recovery, and creativity. These three properties pertain to a community's ability to withstand the impacts of a disaster (resistance), return to pre-disaster functioning (recovery), and adapt to new challenges and learn from their experiences so they can achieve higher levels of functioning (creativity). More specifically, research into the experiences of individuals and groups highlights the temporal changes in the types and levels of resources and capabilities that are required for people to successfully negotiate the challenges of a hazard event. By analysing a number of disasters, Paton and his colleagues (e.g., Paton et al., 2014; Paton & McClure, 2013) found that a set of interacting social attributes at the individual, family, community, and societal levels have been shown to positively (and for some, negatively) affect adaptive processes and capacities at different post-disaster stages (Figure 5.2). Drawing on some of the concepts from Paton's model, Khalili et al. (2015) propose a temporal framework on social disaster resilience that focuses on both cognitive and structural attributes of social resilience (Table 5.2). Their investigation indicates that different social attributes exert differential influences on the efficacy of activities across the disaster cycle. The study found that factors including community participation, information exchange, social support, sense of community, and trust consistently contribute to social resilience across all phases of a disaster.

Figure 5.2 Paton's resilience/adaptive capacity model. Reprinted from *Preparing for disaster: Building household and community capacity*, by D. Paton and J. McClure, 2013, p. 205

Table 5.2 *Temporal social resilience indicators matrix*

Level of impact on social resilience	**Social Resilience Indicators**		
High	Community participation Education Exchange information Learning Shared information Social support Sense of community Trust	Community participation Exchange information Shared information Social support Sense of community Trust	Community participation Exchange information Learning Shared information Social support Sense of community Trust
Medium	Demographic information	Coordination	Community efficacy
Low	Improvisation – inventiveness Coping style Leadership	Coping style Leadership	Improvisation – inventiveness Coping style Leadership
	Pre-Disaster	Response	Recovery
	Phases of Disasters		

Note. From "A temporal framework of social resilience indicators of communities to flood, case studies: Wagga wagga and Kempsey, NSW, Australia", by S. Khalili, M. Harre, and P. Morley, 2015, International Journal of Disaster Risk Reduction, 13, p. 253.

5.2.5 Social resilience as a multidimensional concept

The conceptualisation of social resilience is multidimensional, as it is a process and an outcome, possesses structural and cognitive qualities, and spans both spatial and temporal scales. Furthermore, it is inextricably linked with other domains of disaster resilience. According to Morrow (2008), social resilience in local communities is influenced not only by the strengths of social

institutions and social networks, but also by pre-existing economic and political conditions of a community. Because of the complexity inherent in social resilience, existing measurement tools and models consist of a plethora of social resilience categorisations and attributes. Synonyms and sub-categories for the social resilience domains include human capital, lifestyle and community competence, society and economy, community capital, social and cultural capital, population and demographics, and risk knowledge (Ostadtaghizadeh et al., 2015). These conceptualisations and categorisations of resilience of the social environment highlight the difficulties in delineating social resilience with other forms of community resilience components in that the resilience of social units and systems is dependent on the functions of other societal systems, such as ecosystem services (e.g., Berke et al., 2008), physical infrastructure (e.g., Chang & Shinozuka, 2004), and economic activities (Rose, 2007). Hence, the multidimensional nature of social resilience sets the conceptual foundation for this research study, in which research participants were asked to identify pre-disaster structural and cognitive social resilience attributes that they believe would contribute to the capacity of communities at different disaster phases.

5.2.6 Evaluation of social resilience within the disaster management sector

Although research into resilience of the social environment has been found to positively facilitate disaster response and recovery (Aldrich, 2012a; Burton, 2012; Johnston et al., 2011; Paton, Mamula-Seadon, et al., 2013), integration of such findings in local emergency management practices has been mixed in New Zealand and elsewhere. On the one hand, certain emergency management agencies have been actively promoting community-based emergency management efforts through building social resilience, including the Wellington Regional Emergency Management Office and selected cities that participate in the Rockefeller Foundation's 100 Resilient Cities Initiative (The Rockefeller Foundation, 2015; WREMO, 2012). On the other hand, the importance of community resources and competence at different disaster phases has yet to be fully acknowledged by the wider emergency management sector (Murphy, 2007). Alshehri, Rezgui, and Li (2015) found that resilience experts from a cross section of organisations and functions placed social resilience factors (out of other resilience indicators including health and well-being, governance, physical and environmental, economic, information, and community) as the least important in contributing to post-disaster response and recovery. Recent disasters, such as Hurricane Sandy on the U.S. East Coast in 2012 and the Canterbury earthquakes in Christchurch, New Zealand, in 2011 and 2012, also highlight the need to fully integrate community-based disaster response efforts with those initiated by governments (Feuer, 2012; Montgomery, 2013).

Experiences from past disasters have led to a growing recognition by emergency management agencies on the value of engaging local communities in understanding the broader scope of disaster risks and resilience. Increasingly, research studies have looked into how social resilience is evaluated by different stakeholders, but there is still much to learn. Some attempts to capture various aspects of cognitive and structural dimensions of social resilience from the local perspectives have been carried out, including those that focused solely on the perspectives of community residents (Cox & Hamlen, 2014; Freitag et al., 2014) and those that captured the perspectives of practitioners (Khalili et al., 2015; Orencio & Fujii, 2013; Singh-Peterson et al., 2014). Yet, there is a gap in bridging the diverse perspectives of stakeholders on what factors contribute to social resilience at the community level and how they can be assessed and cultivated locally.

To address this literature gap, this paper seeks to identify the core social resilience factors from a variety of individuals whose primary job functions are to promote community resilience. A workshop among researchers, practitioners, and policymakers was conducted to evaluate their perspectives on social resilience at the community level. The workshop sought to address two research questions: 1) What social factors positively contribute to community disaster resilience?, and 2) How can communities develop, integrate, and cultivate social resilience prior to a disaster?

5.3 Methods

This workshop was held in October 2015 with hazards researchers, emergency management practitioners, and policymakers at the Wellington Region Emergency Management Office in Wellington, New Zealand. To answer the stated research questions, workshop participants were tasked with identifying from their perspectives the social factors that influence neighbourhoods' ability to anticipate, respond to, and recover from disasters. The workshop consisted of a series of structured group interviews (Frey & Fontana, 1991) that sought to achieve three objectives: 1) define what social resilience means to them, 2) identify what factors are important in building social resilience of communities, and 3) identify existing and potential programmes that enhance social resilience of communities.

5.3.1 Participant recruitment

Participants were recruited through the International Centre of Excellence in Community Resilience (ICoE:CR) database. As designated by the International Risk and Disaster Reduction (IRDR), the ICoE:CR, which is a joint initiative between the WREMO and the Joint Centre for Disaster Research at Massey University, bridges science and practice to advance community resilience for the Wellington

region. The 13 participants included six academic researchers, six emergency management practitioners from both public and private sectors, and one policymaker from the government.

5.3.2 Workshop facilitation instrument

The workshop was facilitated using the Technology of Participation (ToP) method (The Institute of Cultural Affairs, n.d.). The ToP method is a brainstorming technique that incorporates the process of organising, integrating, and making sense of different ideas (Stanfield, 2002). The facilitation method is informed by the Delphi process, in which the researcher summarises individual expert opinions and solicits consensus through an iterative process (Okoli & Pawlowski, 2004; Ritchie & Lewis, 2003), but in contrast to the Delphi process, participants also engage in organising (or clustering) of the data (Stanfield, 2002). This method allows the group to develop themes based on individual contributions and has been used in a variety of research and non-academic settings to engage people in communities and organisations in planning and problem-solving (The Institute of Cultural Affairs, n.d.; Umpleby, Medvedeva, & Oyler, 2004).

5.3.3 Workshop procedures

To achieve the objectives of the workshop, it was structured into four related activity segments described below. Workshop participants were divided into three groups; participants selected their own group. The workshop lasted a total of two and a half hours.

5.3.3.1 Activity 1: Setting the stage – Contextualising community disaster resilience (15 minutes)

In the first segment, the workshop facilitator (the primary author of this research) set the stage for the workshop by asking participants to define community disaster resilience. For the purpose of the workshop, community disaster resilience was framed as 'community strengths', which is referred to as

> the extent to which resources and processes within a community maintain and enhance both individual and collective wellbeing in ways consistent with the principles of equity, comprehensiveness, participation, self-reliance and social responsibility. This definition implies that an assessment of community strength involves taking account of resources, processes and outcomes (Black & Hughes, 2001, p.3).

The framing of community disaster resilience as strengths aligns with the current discourse of resilience as an asset-based concept (Freitag et al., 2014; Renschler et al., 2010). Although recent conceptualisation of community disaster resilience over the past decade describes it as 'adaptive capacity' (Becker et al., 2013; Berkes, 2007; Klein et al., 2003; Norris et al., 2008; Paton, 2006a), the interpretation of resilience as strengths sought to discretely define the concept of resilience to

include community capacities, qualities, values, and processes. By framing community disaster resilience as community strengths, workshop participants completed the statement, "A resilient community is/has…" by writing out one to three-word responses. This exercise served to 'warm-up' participants for the next three core activity segments.

5.3.3.2 Activity 2: Defining social resilience (40 minutes)

Following the first activity, the workshop facilitator narrowed the focus of the workshop by engaging participants to define and discuss the attributes of social resilience. Social resilience was framed as 'social strengths', which entail community resources and processes that pertain to the social environment (Morrow, 2008). The facilitator guided the discussions on social resilience by delineating the concept into four overarching categories, as shown in Table 5.3, which represent both the structural and cognitive components of social resilience.

Table 5.3 *Social resilience categories*

Social resilience categories	References
Skills, abilities, and knowledge	Mayunga, 2009; Wisner & Adams, 2002
Qualities and amenities	Cutter et al., 2008b; Rung, Broyles, Mowen, Gustat, & Sothern, 2011; Shaw & Kobayashi, 2001
Values and perceptions	Adger et al., 2009; McIvor & Paton, 2007; Paton, Bajek, Okada, & McIvor, 2010
Community processes	Coles & Buckle, 2004; Lebel, Anderies, Campbell, & Folke, 2006

Participants were asked the following questions:

- What skills and knowledge are important for building, enhancing, and sustaining the social strengths of a community?
- What community qualities and amenities are important?
- What do people feel, believe, value about their community?
- How does a strong community operate?

Participants first responded to these questions individually by writing down key words, concepts, or phrases on colour-coded response sheets that correspond to participants' self-identified occupational functions (Figure 5.3). By soliciting individual responses, we aimed to avoid the potential bias of participants' responses being influenced by the opinions of other workshop attendees and by pre-existing relationships between participants (Frey & Fontana, 1991). Participants in each group then discussed, prioritised, and selected the three most important attributes for each social resilience dimension. The prioritised attributes were then compiled and thematically categorised by workshop participants.

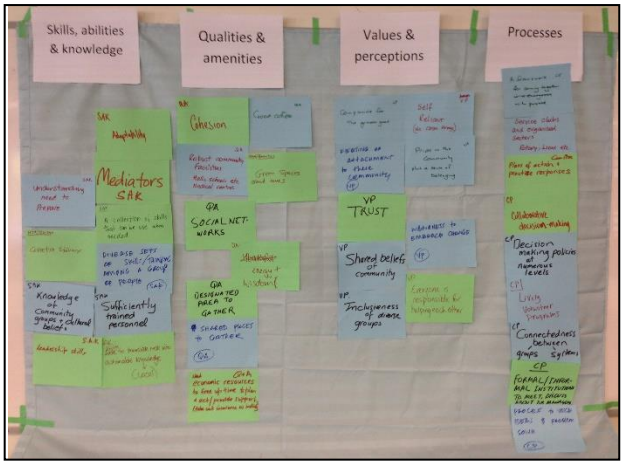

Figure 5.3 Colour-coded participants' responses on the four dimensions of social resilience. Author's photo, 2015.

5.3.3.3 Activity 3: Exploring the temporal dimensions of social resilience (50 minutes)

Once the responses were thematically grouped, participants evaluated the temporal importance of the attributes on the different phases of a disaster – reduction, readiness, response, and recovery. In contrast to a previous study conducted by Khalili et al. (2015), in which emergency practitioners prioritised the importance of a given set of pre-identified social resilience indicators based on their levels of impacts at different disaster phases, this research asked participants to assess the importance of their previously identified responses for each of the four Rs.

5.3.3.4 Activity 4: Identifying social resilience strategies and actions (15 minutes)

During the last workshop segment, participants used colour-coded sticky notes to identify existing activities and suggest potential actions that would cultivate and enhance each of the previously identified social resilience attributes (Figure 5.4). Each of the three participant groups – practitioners, policymakers, and researchers – was asked to write down existing programmes, policies, and ideas.

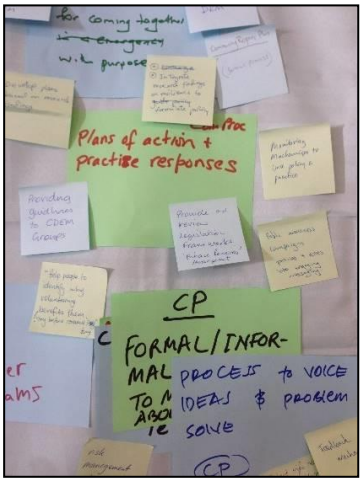

Figure 5.4 *Identification of existing and potential community resilience-enhancing activities. Author's photo, 2015.*

In summary, these four workshop activity segments and their corresponding topic questions are outlined in Table 5.4.

Table 5.4 *Workshop segment objectives and corresponding questions pertaining to social resilience*

Workshop segment objective	Questions asked of the participants
Setting the stage Contextualising community resilience	A resilient community is/has…
Defining social resilience	What skills and knowledge are important for building, enhancing, and sustaining the social strengths of a community? What community qualities and amenities are important? What do people feel, believe, value in their community? How does a strong community operate?
Determining the temporal dimensions of social resilience	What are some key characteristics and processes that enable communities to better mitigate, prepare for, respond, and recover from disasters (the 4 Rs)?
Evaluating existing social resilience programmes	Practitioners: What is your organisation doing to facilitate these attributes? Researchers: How might people, government agencies and community-based organisations help to facilitate these attributes? Policymakers: What policies and actions exist to either mandate or support communities to enhance their resilience?

5.3.4 Data analysis

The four workshop activities resulted in three sets of data: Individual responses to workshop activity questions, responses identified as a group (i.e., prioritised and categorised social resilience attributes), and transcribed discussions between members of each group and between groups.

These three datasets were thematically analysed based on the methods outlined by Braun and Clarke (2006). First, each individual response was coded into social resilience attribute(s), with some responses yielding two or more attributes. Prioritised social resilience attributes were also individually coded. Second, once all the attributes were aggregated, they were refined and cross-validated using the transcribed discussions. Similar attributes were combined and certain attributes were further refined through disaggregation. Last, overarching thematic attributes and sub-attributes were developed based on the responses of participants, as well as recurring themes and theories from the literature. This recursive process of coding and theme development ensured a more accurate reflection of workshop participants' priorities and insights.

5.4 Results

5.4.1 Contextualising community disaster resilience

Participants' responses to the statement, "A resilient community is/has…", were thematically analysed and grouped. The thematically-coded attributes are listed in Appendix 16. Some of the key

attributes identified by participants pertain to community governance, which includes having plans developed and the presence of strong leadership at the grassroots and government levels; knowledge of hazards, risks, and community assets and gaps; availability of resources – human, financial, goods and services; as well as strong and connected social and institutional networks. Many of the attributes described by participants in this activity are also cited in subsequent workshop activities that sought to narrow the scope of resilience to the social environment.

5.4.2 Social resilience attributes

From workshop activity 2, participants unpacked the concept of social resilience and came up with 58 unique responses (after similar responses were combined) for the four categories of social resilience (Appendix 17). These responses, along with the transcriptions of the discussions, were then thematically analysed. The resulting analysis of these data sources resulted in 66 unique attributes and sub-attributes. The frequencies of these attributes were tallied and the most frequently cited social resilience attributes are shown in Table 5.5.

Table 5.5 *Most frequently cited social resilience attributes, by frequency*

Attribute	Number of mentions (n)
Community gathering place	9
Social support	5
Knowledge of risks and consequences	4
Collective efficacy (problem-solving)	4
Sense of community	4

Among researchers, community gathering place is cited most often, followed equally by adaptability, problem-solving skills, psychological support, knowledge of risks and potential hazard consequences, respect for others, and social networks and support. For practitioners, the most frequently identified attribute is a sense of community, followed equally by knowledge of community resources and social support, then equally by clear communication, community events and gathering place, knowledge of risks and hazard consequences, collective efficacy and trust. Since there was only one policymaker in attendance, none of this participant's responses were analysed by frequency (Table 5.6). Responses from researchers and practitioners revealed many similarities. Of the 66 attributes and sub-attributes, 23 were shared by at least two functional participant groups (Table 5.7). All the responses from the policymaker were shared by either researchers or practitioners.

Table 5.6 *Most frequently cited social resilience attributes, by participant's role and number of mentions per attribute*

	Researchers	**Practitioners**	**Policymaker** (n=1)
Most mentioned	Community gathering place (6)	Sense of community (4)	Community gathering place Decision-making
Other frequently mentioned attributes	Adaptability (2) Collective efficacy (problem-solving) (2) Knowledge of risks and hazard consequences (2) Mutual respect (2) Psychological support (2) Social networks (2) Social support (2)	Knowledge of community resources (3) Social support (3) Collective efficacy (problem-solving) (2) Communication (2) Community events (2) Community gathering place (2) Knowledge of risks and hazard consequences (2) Trust (2)	Disaster management planning Knowledge of risks and hazard consequences Planning – exercises Positive outcome expectancy Self-efficacy

Table 5.7 *A list of common attributes shared by researchers, practitioners, and/or policymakers*

Social resilience attribute	**Researchers** (n=6)	**Practitioners** (n=6)	**Policymaker** (n=1)
Adaptability – ability to respond to changes	X	X	
Communication	X	X	
Community gathering place	X	X	X
Decision-making	X	X	X
Having/giving voice	X	X	
Economic resilience	X	X	
Inclusiveness	X	X	
Knowledge	X	X	X
Community resources	X	X	
Risks and potential consequences	X	X	X
Leadership	X	X	
Planning	X	X	X
Exercises	X	X	X
Pride	X	X	
Shared culture and beliefs	X	X	
Self-efficacy		X	X
Skills and abilities	X	X	
Diversity of skills	X	X	
Problem-solving abilities	X	X	
Trained personnel	X	X	
Social cohesion	X	X	
Social networks	X	X	
Social support	X	X	

These common attributes span individual and group scales. Social resilience attributes such as self-efficacy and knowledge of hazard risks and community resources reflect individual-level capacities, while other attributes such as leadership, social support and networks, and shared cultural beliefs occur at the group-level or higher (Khalili et al., 2015; Paton, Mamula-Seadon, et al., 2013). Other attributes consisting of economic (e.g., economic resilience), physical (e.g., community gathering place), and governance (e.g., planning and decision making) characteristics have also been identified by workshop participants.

In workshop activity 2, after responding individually to questions relating to the four categories of social resilience, participants then shared their responses within their group. As a group, they were tasked with prioritising the top three responses for each of the social resilience categories (a few groups provided more than three responses per category). Transcriptions of discussions among participants clarified the intent and meanings for each of the attributes. After the prioritisation process, the three participant groups came up with 28 unique social resilience attributes (Table 5.8).

Table 5.8 *A list of prioritised attributes of social resilience, by social resilience dimensions*

Social resilience category	**Social resilience attribute**
Skills, abilities, and knowledge	Ability to translate risk into actionable (local) knowledge Adaptability – ability to embrace change Collective efficacy – ability to problem-solve Diversity of skills (e.g., mediation) Sufficiently trained personnel Leadership Energy and wisdom Knowledge of community assets and beliefs Understanding the need to prepare
Community qualities and amenities	Community cohesion Economic resilience (resources) Presence of greenery Robust community facilities Community gathering place Social networks
Community values and perceptions	Pride Compromise for the greater good Inclusiveness (of diverse groups) Self-efficacy Sense of attachment Shared beliefs Social support Trust
Community processes	Planning – community plans A framework for collaboration Collaborative decision-making policies and processes Process to voice ideas and problem solve Connectedness between groups and societal systems

For the category of skills, abilities, and knowledge, workshop participants identified the need to have a diversity of skillsets that includes an ability to embrace change, lead, problem-solve, and put knowledge into action. People's knowledge of group resources and understanding of the need to prepare for disasters are also essential to building the resilience of communities. In terms of community qualities and amenities, participants deemed robust facilities and the natural environment as important in contributing to social resilience.

Underlying these abilities and amenities are qualities and values that enhance the strengths of communities, from having a sense of trust and community attachment to having shared beliefs and

inclusive social networks. These attributes support how communities get things done. Participants identified that a strong community requires community disaster planning and a collaborative and inclusive decision-making process. As illustrated by these prioritised attributes, social resilience comprises more than simply social connections. It reflects a multitude of interconnected community traits and functions that are discussed in Section 5.1.

5.4.3 Temporality of social resilience attributes

There was a general consensus among both researchers and practitioners that all of the social resilience attributes are important to all phases of a disaster. However, these same attributes manifest themselves differently throughout the disaster cycle as they take on various roles and exert differential urgency across different disaster phases. For instance, as a practitioner explained, levels of social connectedness within a community heighten and are more robust during disaster response, as compared to the more subdued interactions during the preparedness and recovery phases.

Another discussion strand relates to the quality and sustainability of both cognitive and structural social resilience attributes. The differential pressures placed on these attributes before and after disasters affect their ability to absorb the disaster impacts. As one participant noted, community qualities such as inclusiveness of diverse groups might be tolerated when people are not under stress, but such qualities might become strained under the intense pressure to return to normality and plan for community recovery. The sustainability of resources that support disaster response and recovery was raised by workshop participants as a key component in response and recovery. Practitioners in the workshop pointed out the importance of having a sustainable source of skilled workers to meet both short-term and long-term demands. They stated that the lack of a sustainable source of workforce in past disasters was a major challenge for emergency management planners to contend with in anticipation of future events. They also raised concerns about sustaining vital resources, such as human and financial resources, during long-term recovery, when resources that had poured in during the disaster response phase dry up.

5.5 Discussion

5.5.1 Linkages of social resilience to other disaster resilience domains

The prioritised social resilience attributes (see Table 5.8) generated a number of discussion themes. One of the themes revolved around the interdependencies of social resilience to other domains of disaster resilience (e.g., economic resilience). One of the challenges in demarcating social resilience factors is their interdependence and interlinked relationships with other resilience factors (Adger,

2000; Ostadtaghizadeh et al., 2015). The social resilience categories used in the workshop (i.e., skills, abilities, knowledge; qualities and amenities; values and perceptions; and community processes) acknowledge and reflect these inherent linkages. The category of skills, abilities, and knowledge can be referred to as human capital (Keeley, 2007). Qualities and amenities are related to the built environment. Community processes recognise the importance of neighbourhood governance structures and processes. In addition to these forms of linkages, participants also mentioned economic resilience and the resilience of the natural environment as essential to building social resilience of communities. These linkages are briefly described next.

5.5.1.1 Governance

Workshop participants highlighted that resilient communities must have collaborative and inclusive decision-making processes in place. Within the context of disaster management, governance focuses on the arrangements and processes of individual and organisational actors in pursuit of coordinated decision-making and action (Tierney, 2012). Much of the research within the context of disaster governance focuses on structural processes that include the efficacy of policies in reducing community vulnerability (e.g., Burby, 2006; Gaillard, 2010), promotion of cross-sector integration and partnerships (e.g, Simo & Bies, 2007; Vogel et al., 2007), and creation of a framework for decision-making processes that engages all segments of communities, including indigenous populations and those who are under-represented (King, 2008; Pearce, 2003). These processes are inextricably linked to and reinforce other resilience domains, whether that is acceleration of economic growth, sustainable management of natural resources, or promotion of social development (Adger, Hughes, Folke, Carpenter, & Rockstrom, 2005; Ahrens & Rudolph, 2006).

Although in-depth analysis of governance is beyond the scope of this paper, it should be acknowledged that the qualities underpinning effective governance relate to people's perceptions of trust, inclusiveness, and effectiveness of leaders (Purdue, 2001). Whether people trust the government (Paton, 2007b, 2008), feel they are included in decision-making processes (Newport & Jawahar, 2003; Olshansky, 2006), or believe that their leaders are effective (Paton, Mamula-Seadon, et al., 2013; Rubin, Saperstein, & Barbee, 1985) will have significant influence on whether they will be prepared for potential disaster consequences and make decisions for the community that expedite and improve the quality of their response and recovery.

5.5.1.2 Built environment

Participants viewed community gathering places as essential to social resilience. They pointed to community sanctuaries and gathering places such as schools, local businesses, community centres,

and public spaces as a critical component in building connected communities and supporting disaster response and recovery. These places create opportunities for the development of social capital and serve to provide a variety of services that meet the specific needs of a community, all of which help aid neighbourhoods to recover (e.g., Aldrich & Meyer, 2014; Chamlee-Wright & Storr, 2009a).

Examples from past disasters cemented the critical functions of community gathering places in disaster management. In post-Katrina New Orleans, a local Vietnamese church served as a glue for the community and provided ethnically based services such as religious services, language training, markets, and meeting spaces for social gatherings (Chamlee-Wright & Storr, 2009a). These "club goods" facilitated the return of residents to the neighbourhood and promoted political collective actions to protect their community (Chamlee-Wright & Storr, 2009a, p. 431).

In Christchurch, after the Canterbury earthquakes, the importance of physical public spaces was exemplified by community efforts to transform demolished sites into temporary art installations and community gathering places, which enabled people to come together and test creative reconstruction ideas (Vallance, 2014). The integrity of physical assets, therefore, promotes social recovery through maintaining and rebuilding the social fabric of neighbourhoods.

5.5.1.3 Human capital

The knowledge, skills, and competencies of people – human capital – serve as a basis for societal functions (Keeley, 2007). Workshop participants recognised the need for diverse skillsets, especially in a post-disaster environment. Since disaster management is a multi-faceted field involving multiple interconnected stakeholders and organisations, a variety of skillsets are needed to perform the necessary activities required before, during, and after a disaster (Mayunga, 2007). Because many of the skilled professionals and volunteers are not involved in disaster management in their day-to-day work, the ability of local governments and communities to draw on their experiences and expertise and to create a mechanism for them to contribute in disaster management activities are essential in enhancing disaster resilience.

One of the key skills identified by practitioners was leadership. Both established and emergent community-based leaders are essential to effective disaster response and recovery, as they possess the necessary skills and connections to other communities, NGOs, and different levels of government agencies that enable communities to self-organise, assess and acquire reliable information and resources, and prioritise recovery activities (Paton, Mamula-Seadon, et al., 2013; Rubin et al., 1985). Furthermore, local leaders can help promote an environment of inclusiveness and trust that lays the foundation for collective action (Paton & Irons, 2016). In the aftermath of the

Canterbury earthquakes, Paton et al. (Paton, Mamula-Seadon, et al., 2013) found that the emergence of leaders was crucial to a neighbourhood's medium- to long-term recovery.

5.5.1.4 Economic resilience

Not surprisingly, workshop participants identified economic resilience as one of the priority components that contribute to social resilience. Their understanding of economic resilience at an individual level (e.g., availability of emergency funds) and at the neighbourhood level (e.g., vitality of local businesses) align with existing research that demonstrates the importance of economic resources to overall resilience of neighbourhoods (Rose, 2007). At the household and neighbourhood levels, economic resilience is underscored by the availability of livelihood opportunities, equitable distribution or access to resources, existence of robust economic activities or diversity, and limited exposure of economic assets to hazard risks (Adger, 1999; Norris et al., 2008). Wider institutional constraints, such as the lack of mobility and access to financial capital and social networks, can hamper a pre-existing economically vulnerable population from taking protective measures against hazard impacts and essential recovery activities (Adger, 1999; Cutter et al., 2006). Thus, the relationship of social and economic resilience is mutually reinforcing.

5.5.1.5 Natural environment

External stresses produced by hazard events have been linked to post-disaster trauma and mental health symptoms (Norris et al., 2002). As such, a recurring feature of social resilience discussed in the workshop is the presence of 'greenery' in the urban landscape. Greenscape acts as a mediating factor in enhancing people's psychological health and social well-being (Grinde & Patil, 2009; Health Council of the Netherlands; Shanahan et al., 2015). With a large body of empirical evidence linking urban green spaces to public health and social well-being, there is a growing recognition within the academic and policy communities of the importance of promoting green spaces as part of a suite of activities to enhance disaster resilience (Tidball & Krasny, 2014). For instance, Tidball and Krasny (2007) argue that urban community greening initiatives, such as the development of community gardens, foster community diversity, citizen participation, and the development of collective skillsets (e.g., self-organisation, learning, and adaptation) that enable local communities to more effectively prepare for, respond to, and recover from disasters. As expressed by a workshop participant, the natural environment serves as both passive and active forms of resilience building. It is passive in that the visual exposure of nature contributes to improved mental health; and it is active in that green spaces create opportunities for people to coalesce toward common processes and goals.

5.5.1.6 Reframing social resilience

The social resilience of communities, therefore, is linked to neighbourhood and societal governance structures and processes, the built environment, human capital, economic resilience, and the natural environment. As illustrated in previous sections, the ability of a neighbourhood's social environment to effectively anticipate, cope with, and recover from disasters rests on the presence and robustness of other neighbourhood features, resources, and processes. In Figure 5.5, the supporting elements of social resilience reflect existing framing of disaster resilience into different societal dimensions (Cutter et al., 2008a). These elements include a community that possess a diversity of skillsets which can be drawn upon at different phases of a disaster; robust built infrastructure and amenities that facilitate social functioning of a community; an inclusive governance structure that allows for meaningful input by local stakeholders; equal access to and allocation of economic resources that strengthen people's and communities' pre-disaster functions and enable speedy recovery; and access to the natural environment that promotes social well-being and capacities. Thus, the measurement of social strengths of a community needs to recognise the interdependencies of social resilience to other forms of disaster resilience.

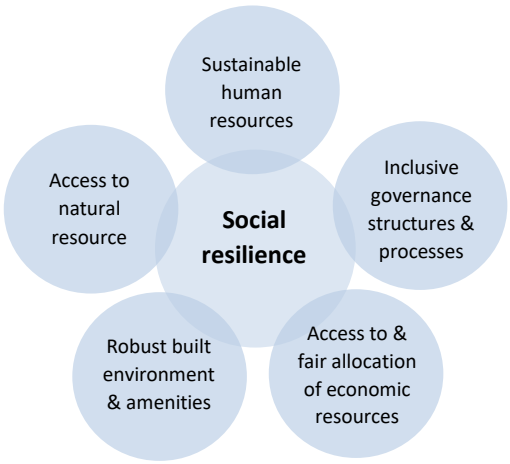

Figure 5.5 Supporting components of social resilience – linkages to other neighbourhood features, characteristics, and processes. Adapted from "A place-based model for understanding community resilience to natural disasters", by S. L. Cutter, L. Barnes, M. Berry, C. Burton, E. Evans, E. Tate, and J. Webb, 2008, *Global Environmental Change, 18*(4), p. 604.

5.5.2 Temporal manifestation and sustainability of social resilience attributes

Participants also discussed the manifestation and fragility of social resilience attributes as they change over time. As expressed by practitioners, the levels of resources in a post-disaster environment vary temporally. This sentiment reflects the documented phenomenon of altruistic activities immediately following a disaster (Feuer, 2012; Hayward, 2013). However, altruistic actions are not equally distributed (Krzysztof Kaniasty & Norris, 1995) and diminish over time (Zakour &

Gillespie, 2013a). Similarly, tangible assets such as green spaces and community facilities serve different functions during disasters. Neighbourhood schools and parks provide residents with a venue to gather, learn, and connect pre-disasters. In a post-disaster environment, these same places serve very different purposes. They might become temporary places for information dissemination and shelters immediately following a disaster and serve to promote health and well-being during the recovery phase (Rung et al., 2011; Shaw & Kobayashi, 2001).

An important aspect of the temporality of social resilience relates to how the structural and cognitive components of social resilience sustain over time. The notions of sustainability and disaster resilience are inextricably related (Tobin, 1999). The conceptualisation of disaster resilience that incorporates the perspective of sustainability, which reflects the long-term survivability and progress of societies (Brown, Hanson, Liverman, & Merideth, 1987; Turner II, 2010), is integral in the framing of resilience by hazards researchers (e.g., Adger et al, 2005; Paton & Johnston, 2006) and international policies (e.g., UNISDR 2005, 2015a). Sustainability measures of the social environment have been used in longitudinal assessments that sought to evaluate the quality and functionality of systems that support the social functions of people and communities in pre- and post-disaster environments (Bozza et al., 2015; Canterbury Earthquake Recovery Authority, 2014).

5.6 Proposed core social resilience indicators

By synthesising the list of attributes from Table 5.7 and Table 5.8, themes arising from participant discussions and from existing literature on disaster resilience measurements, a core set of social resilience attributes is proposed (Table 5.9). The core attributes are categorised based on the cognitive and structural dimensions. These attributes are accompanied by supporting research studies that demonstrate their positive contributions to disaster resilience. Unlike other social resilience indicators, this set of core attributes encompasses attributes from other societal domains – namely human capital, economic resilience, the built environment, and governance – that are essential in enhancing neighbourhood-level social resilience.

Table 5.9 *Core attributes of social resilience and accompanying resilience-enhancing actions, based upon participant perspectives listed in Tables 5.7 and 5.8 and related key literature associated for each attribute*

Social resilience dimension	Social resilience attribute	References	Actions suggested by participants
Cognitive	Adaptability – ability to embrace change	Buikstra et al., 2010; Folke, Colding, & Berkes, 2003	---
	Collective efficacy	Paton et al., 2014	Identify other community problems they can solve together/have solved together
	Community inclusiveness	Burby, 2003; Ganapati, 2012; Paton et al., 2014	Work with indigenous groups to increase their involvement in disaster risk management

			(DRM); community plans that accommodate diverse populations
	Connectedness between networks	Aldrich, 2012a; Berke & Campanella, 2006	Plan to hold community activities; connecting groups via social media (e.g., Facebook)
	Leadership	Olshansky, Johnson, Horne, & Nee, 2008; Paton, Mamula-Seadon, et al., 2013; Rubin et al., 1985	Enhance local government understanding of and encourage local leadership in DRM
	Sense of community and attachment	Norris et al., 2008; Paton, McClure, et al., 2006	Community activities such as simulated disaster response exercises
	Shared community beliefs and values	Buckle, 2006; Buikstra et al., 2010	Identify other community problems they can solve together/have solved together (same as above – collective efficacy)
	Social support	Berkes & Ross, 2013; LaLone, 2012; Paton et al., 2014	---
	Trust	Nakagawa & Shaw, 2004; Paton, 2008	Engage the community in community disaster response planning and help identify what resources are available in the community
Structural	Access to economic resources	Norris et al., 2008	---
	Community (and individual) preparedness	Ardagh et al., 2012; Becker, Paton, Johnston, & Ronan, 2012	Set realistic expectations for official response; promote business continuity management; promote the 4R approach for all hazards; have preparedness enablers (e.g., individual and community water tanks and grab-and-go kits)
	Democratic and collaborative decision-making and problem-solving policies and processes	King, 2008; Olshansky et al., 2008; Pearce, 2003	Work with all of government to increase DRM; expert information needs to be tailored to situation and audience; combine bottom-up and top-down information; walk the talk and don't dictate; integrate feedback mechanisms; have a framework for decision-making processes in disaster management policies
	Disaster management planning	Becker et al., 2013; Olshansky et al., 2008	Have a monitoring mechanism to link policy and practice; develop plans based on research findings; review legislation frameworks, including 'enhanced recovery' management; provide guidelines to local and regional emergency management groups
	Diversity of skills and trained personnel	Wisner & Adams, 2002	Emergency skills trainings; institute or enhance volunteer programmes; individual level trainings (i.e., CPR, stress reduction)
	Knowledge of community assets and beliefs	Freitag et al., 2014	Identify community strengths and gaps (mapping resources); contacting and listening to local organisations
	Knowledge of risks and hazard consequences	Paton et al., 2008	National resilience policies with stated goals of communities understanding and managing their hazards; Public education programmes such as 'Shakeout'; public awareness campaigns
	Robust community spaces and amenities	Chamlee-Wright & Storr, 2009a	Community-operated emergency management centres; local government engages early with community to identify resources within the community
	Social networks	Aldrich & Meyer, 2014	Find funding for grassroots groups

Although there are many facets to social resilience, this core set of attributes serves as a basis for assessing neighbourhood-level social resilience and provides actionable strategies and programmes that can help guide emergency management agencies interested in promoting social resilience in local communities.

5.7 Conclusion

With an increasing investment in building neighbourhoods that are resilient to natural hazards, it is crucial to track progress towards resilience. However, challenges abound when trying to measure neighbourhood-level disaster resilience, whether that stems from the very definition of resilience or disagreements between different stakeholders on what should be measured and how to go about measuring it. These challenges boil down to one fundamental question: resilience of what and for whom? In order to build neighbourhood resilience, an essential task is to understand what resilience means to those who are embedded in resilience-building efforts. This research sought to examine one aspect of disaster resilience – social strengths of people and communities – by soliciting the perspectives of local practitioners, policymakers, and researchers on what they believe are essential attributes of social resilience.

The perspectives of practitioners, researchers, and policymakers revealed the structural and cognitive properties of social resilience. Enhancing social resilience requires not only the necessary personnel, economic resources, and community physical assets, but it also entails 'resilient' attitudes and beliefs that drive positive resolutions to disaster-related challenges. These include whether people can work together to solve problems (collective efficacy), a sense of place attachment among community members, and existing and potential leadership, among others. Therefore, the proposed core social resilience indicators capture a combination of structural and cognitive attributes that have been identified in the workshop. Measurement tools and scales for many of these indicators already exist. Hence, they can serve as an evaluation framework and performance metrics for assessing existing levels of social resilience of neighbourhoods and resilience building programmes. The suggested strategies and actions in Table 5.9 also provide policy and programme guidance for local entities on strengthening social resilience of people and communities.

Although the results of this workshop suggest a robust flow of information between researchers and practitioners, there is a continual need to bridge research and practice in understanding the drivers of disaster resilience; in assessing pre-disaster levels of these attributes in communities; and in integrating social resilience measurements, strategies, and actions in local resilience programmes.

One area of focus centres on cultivating social resilience attributes in local communities. Social resilience attributes, such as trust and community inclusiveness, can be difficult to cultivate in the field. Social interactions between individuals are to an extent self-selected, and engineering such interactions between diverse groups requires a significant amount of time and effort – resources that few agencies can afford.

A way forward for neighbourhoods to increase their social resilience is through learning from local best practices that have integrated social resilience attributes into new and existing community programmes. Becker et al. (2011) have compiled best practices of community resilience initiatives and programmes that align with evidence-based social resilience indicators (i.e., self-efficacy, outcome expectancy, critical awareness, action coping, community participation, articulating problems, empowerment, trust and resources) for the emergency management sector in New Zealand. As local communities increasingly engage in resilience-building efforts, researchers should work alongside with local practitioners to evaluate the efficacy that different actions have on the social resilience levels of communities, and to share those learnings with the wider emergency management field. The activities also create opportunities for collaborative trans-disciplinary citizen science initiatives (Orchiston et al., 2016).

Another area of focus in bridging research and practice is the inclusion of the perspectives of local communities that, unlike their research and policy counterparts, are not necessarily active in promoting and building resilience. Although the proposed core set of social resilience indicators have been developed from expert opinions of researchers, practitioners, and policymakers, future studies need to examine whether these indicators reflect the priorities of community members in preparing for, responding to, and recovering from disasters. Thus, this research serves as a foundation for future examinations of the proposed indicators' validity and relevance to local communities, especially in terms of evaluating the appropriateness and efficacy of capacity-building programmes.

5.8. Link to Chapter 6 – Paper 2

As discussed in Chapter 2, essential to developing neighbourhood disaster resilience and effective interventions is an integration of both expert and local knowledge (Davies et al., 2015; Gaillard & Mercer, 2013). This chapter describes how experts (i.e., hazard researchers, emergency management practitioners, and a policymaker) – in a workshop format – conceptualised social resilience and presents a resilience assessment framework that is based on their perspectives. However, a research gap remains in understanding how local stakeholders define their

neighbourhood's resilience, and identifying assessment measures that reflect their values, needs and priorities.

To address this gap, the following chapter (Chapter 6 – Paper 2, Kwok, Paton, et al., 2018) examines the perspectives of neighbourhood stakeholders on social resilience. As part of research project #2 (refer to Section 3.3), nine focus groups across five different neighbourhoods in the Wellington region and in San Francisco were conducted. Chapter 6 presents data from the focus groups and describes the process in deriving resilience measurement themes by examining the perspectives of stakeholders from the study's neighbourhoods. It discusses findings that pertain to local stakeholders' community values, and their views about the concept of disaster resilience and the essential characteristics that they believe would contribute to neighbourhood resilience.

Chapter 6 – Paper 2: A bottom-up approach to developing a neighbourhood-based resilience measurement framework

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Abstract

Purpose – As disaster resilience activities are increasingly occurring at the neighbourhood level, there is a growing recognition in research and in practice of the contributions that community stakeholders can make in assessing the resilience of their communities. The purpose of this paper is to describe the process in deriving a disaster resilience measurement framework by soliciting the perspectives of stakeholders from urban neighbourhoods in two countries. The authors examine their community values, and their perspectives on both the concept of resilience and the essential elements that they believe would contribute to the resiliency of their neighbourhoods.

Design/methodology/approach – The authors used an appreciative inquiry approach to draw out the perspectives of 58 stakeholders from nine focus groups in five urban neighbourhoods in New Zealand and in the U.S.

Findings – Results of this research show common values and recurring perceived characteristics of disaster resilience across the study sites. A neighbourhood-based disaster resilience measurement framework is developed that encompasses individual/psychological, socio-cultural, economic, infrastructural/built, and institutional/governance dimensions of disaster resilience. In the process of developing the framework, the authors identified challenges in engaging certain segments of the population and in accounting for wider structural influences on neighbourhood resilience.

Research limitations/implications – Issues relating to inclusive community engagement and linkages to cross-scalar resilience factors need to be addressed in future studies.

Practical implications – Results of this research provide insights and guidance for policy makers and practitioners when engaging communities in the development of resilience metrics.

Originality/value – This study fills the literature gap in evaluating community values and stakeholders' perspectives on disaster resilience when identifying metrics for resilience interventions in urban neighbourhoods. The proposed measurement framework is derived from cross-cultural and diverse socioeconomic settings.

6.1 Introduction

Building community disaster resilience is integral to disaster risk reduction (DRR) policies and practice (UNISDR, 2015b). Accordingly, there is a pressing need to benchmark existing levels of resilience to aid in the development and evaluation of DRR interventions that meet local needs and enhance communities' abilities to prepare for and respond to natural hazard events (Committee on Increasing National Resilience, 2012). While research into disaster resilience and its measurement continues at a rapid pace, the development of resilience measures that reflect neighbourhood-level conditions remain scarce (Eisenman et al., 2016). To move toward developing a neighbourhood-based disaster resilience measurement framework that reflects the values and needs of neighbourhood stakeholders, this research study started by conducting focus groups with stakeholders of five different urban neighbourhoods in New Zealand and the United States, investigating what they value in their communities, how they frame disaster resilience, and what they believe to be essential elements that contribute to the resiliency of their communities. This conjoint evaluation approach provides insights into common resilience denominators as well as neighbourhood-specific contextual factors.

6.2 Measuring disaster resilience

Measuring disaster resilience is fraught with challenges, not least because it is a multi-faceted and multi-scalar concept with wide ranging interpretations and ways of measuring it (Committee on Increasing National Resilience, 2012; Cutter, 2016; IFRC, 2016; Ostadtaghizadeh et al., 2015; Sharifi, 2016). Disaster resilience can be conceptualised as community capitals (Ritchie & Gill, 2011), attributes of societal systems such as physical or social units (Renschler et al., 2010), and adaptive capacities (Becker, Johnston, & Paton, 2015; IFRC, 2016; Manyena et al., 2011; Sherrieb et al., 2010). These capitals, attributes, and capacities allow a societal system to either bounce back (i.e., return to

pre-existing functionality) or bounce forward (i.e., adapt to a different reality) from a disaster (Manyena et al., 2011). This paper frames disaster resilience as the adaptive capacities of a social system to bounce forward from a natural hazard event. That is, disaster resilience refers to individuals' and groups' abilities to learn from, adapt to, and co-exist with natural hazards and their potential consequences (Paton & Johnston, 2017).

Increasingly, policymakers, researchers, and practitioners are advocating for measuring disaster resilience as a means to identify areas for improvement, evaluate resilience strategies, and monitor resilience progress (Committee on Increasing National Resilience, 2012). Recent advances in assessment frameworks and tools to benchmark and track resilience progress include the City Fragility and Resilience Framework (de Boer et al., 2016), the 100 Resilient Cities' City Resilience Index (The Rockefeller Foundation & ARUP, 2014), and the One Billion Coalition for Resilience's indicators (IFRC, 2015). In the two countries where this study took place, benchmarking community disaster resilience is integral to the National Preparedness Goal and the National Disaster Recovery Framework in the U.S. (U.S. Department of Homeland Security, 2011b, 2011a) and the National Civil Defence Emergency Management Strategy in New Zealand (Ministry of Civil Defence and Emergency Management, 2012).

6.3 Why assess disaster resilience at the neighbourhood level?

The definition of neighbourhood can be debated without end. This paper adopted Galster's (2001) definition of a neighbourhood as "the bundle of spatially-based attributes associated with clusters of residences, sometimes in conjunction with other land uses" (p. 2112). At the neighbourhood scale, neighbourhood characteristics pertaining to demographics, physical features, environmental conditions, politics, social interactions, and sentiments and perspectives can be examined (Galster, 2001). As such, neighbourhoods comprise diverse communities – groupings of people who share common perspectives or relational ties (MacQueen et al., 2001). As local communities are seen as the frontline in preparing for and dealing with the aftermath of disasters, this diversity creates the need for understanding different perspectives in informing the development of neighbourhood-based resilience measures.

As local units of analysis, neighbourhoods offer unique opportunities for examining interactions between hazards and people's perceptions of and adaptive capacities to those hazards. While neighbourhoods do not have formal governmental authority, they are "locus par excellence of 'informal governance'": people's ability to maintain social order, arrive at collective decisions, and perform public services when a neighbourhood is temporarily cut off from official public services and

authorities (Lelieveldt, 2008, p. 331). Informal governance, through neighbourhood-based organisations and social networks, has demonstrated effectiveness in past disasters (e.g., Hurricane Katrina, the Christchurch earthquakes, and Hurricane Sandy) in several ways: promoting collective actions to address both short- and long-term recovery needs (Graham et al., 2016); supporting pre-existing and emergent community leaders who advocate for obtaining resources from decision-makers in governments (Paton, Mamula-Seadon, et al., 2013); cultivating social connections to bolster social support (Chamlee-Wright & Storr, 2010); and fostering a sense of community attachment that facilitates post-disaster return of residents (Chamlee-Wright & Storr, 2009b). The lessons learned from these experiences have informed how disaster resilience is measured to date (see Cutter, 2016; Ostadtaghizadeh et al., 2015; and Sharifi, 2016).

Although there is a burgeoning of research and development in disaster resilience assessments overall, there is a dearth of research that is geared toward advancing participatory assessments for urban neighbourhoods. The need for comparative analysis by policymakers has contributed to many assessment tools, such as those mentioned in Section 6.2, to measure resilience quantitatively at the city level or higher, where data are more readily available (Committee on Increasing National Resilience, 2012). Much of the existing participatory neighbourhood assessments have generally been implemented in rural communities, such as the Rural Resilience Index (Cox and Hamlen, 2014; IFRC, 2016). The application of rural resilience indicators to urban neighbourhoods, however, would be inappropriate due to distinct differences in the underlying drivers of resilience between rural and urban settings (Cutter, Ash, & Emrich, 2016; International Rescue Committee, 2017).

Another problem is a lack of community input in the development of resilience assessments. While community participation is considered essential to effective resilience planning (Horney, Nguyen, et al., 2016), the incorporation of community input in resilience measuring tools has yet to become standard practice. Of the 36 selected community disaster resilience assessment tools reviewed by Sharifi (2016), only 36% of them used a participatory approach in their development process, while the rest were formulated through the use of literature and expert opinions. That top-down assessment approach could result in a disconnect from the very diverse values and priorities of people who would be most affected by disasters (Gaillard and Mercer, 2013; IFRC, 2016; Sharifi, 2016). Bridging this disconnect requires an understanding of what community members value within the context of assessing community disaster resilience (National Academies of Sciences, Engineering, and Medicine, 2017).

This paper addresses these gaps by seeking to develop a neighbourhood-based resilience measurement framework that can be collaboratively implemented among community members, community-based organisations, and government agencies in the study sites. It describes the use of

a bottom-up approach in deriving key measurement themes through the input from neighbourhood stakeholders during the data collection process and in conducting an inductive analysis of their perspectives.

6.4 Methods

6.4.1 Study sites

The Wellington region of New Zealand and the City and County of San Francisco in the U.S. were chosen for their similar exposure to and risk of significant seismic hazards (Rhoades et al., 2011; U.S. Geological Survey, 2015b). By adopting the spatial boundaries of neighbourhoods used by government planning agencies, five neighbourhoods from these regions were selected. Because past research has shown differential levels of vulnerabilities and resilience between communities with different socioeconomic status and ethnic make-up (Finch et al., 2010), government datasets were used as a starting point to identify potential neighbourhoods that represent varying degrees of socioeconomic levels and ethnic compositions. Without comparable datasets between these two regions, the authors used different sources of data to narrow the list of potential neighbourhoods: the New Zealand Social Deprivation Index (NZDep) – a composite of socioeconomic variables that measure deprivation of small geographic areas across New Zealand on a continuous score, with a mean of 1,000 index points (Atkinson et al., 2014) – for neighbourhoods in the Wellington region, and census data on household income and racial makeup for neighbourhoods in San Francisco (San Francisco Planning Department, 2012; U.S. Census Bureau, 2014).

The primary author of this study shortlisted the number of neighbourhoods in each region by consulting with local emergency management practitioners. Key neighbourhood stakeholders, or gatekeepers, were involved to assist with determining the suitability of their neighbourhoods as study sites. This consultation process resulted in the selection of two neighbourhoods in the Wellington region and three within San Francisco. In the Wellington region, the two neighbourhoods selected were Brooklyn in Wellington city and Cannons Creek in Porirua city (Figures 6.1a and 6.1b). In San Francisco, the three neighbourhoods were Miraloma Park, Bayview, and Chinatown (Figure 6.2).

B. Brooklyn, Wellington city

A. Wellington city and Porirua city, Wellington region

C. Cannons Creek, Porirua city

Figure 6.1 Study sites in the Wellington region: Brooklyn and Cannons Creek (denoted by ★). Retrieved from https://www.openstreetmap.org. Copyright (2017) by OpenStreetMap contributors.

Figure 6.12 Study sites in San Francisco: Miraloma Park, Bayview, and Chinatown (denoted by ★). Retrieved from https://www.openstreetmap.org. Copyright (2017) by OpenStreetMap contributors.

6.4.1.1 Wellington neighbourhoods

The neighbourhoods of Brooklyn and Cannons Creek represent the extreme ends of social deprivation levels in the Wellington region. Brooklyn's NZDep score is below the region's average, and Cannons Creek (consisting of Cannons Creek North, Cannons Creek East, and Cannons Creek South) has one of the highest scores (Table 6.1). Demographically, Brooklyn has a higher percentage of residents who identify as Pākehā/New Zealand European, while Cannons Creek has a majority of residents who identify themselves as Pasifika (or Pacific Islanders), an ethnic minority. Residents in Brooklyn also have higher median household incomes than their counterparts in Cannons Creek, which has a large population living in social housing.

Table 6.1 *Demographics of Brooklyn, Cannons Creek, and Wellington Region*

	Pop.	NZDep Score	Median HH Income (NZD)	Ethnicity (top three)		
Brooklyn	6,504	939	$102,200	European (78.7%)	Asian (11.3%)	Māori (6.5%)
Cannons Creek						
East	3,594	1200	$47,100	Pasifika (65.5%)	European (17.9%)	Māori (17.6%)
South	1,533	1186	$47,200	Pasifika (60.3%)	European (23.9%)	Māori (23.9%)
North	3,132	1238	$38,900	Pasifika (54.0%)	European (23.7%)	Māori (23.3%)
Wellington Region	471,315	973	$74,300	European (73.2%)	Māori (12.4%)	Asian (10.0%)

Note. From http://atlas.idnz.co.nz/.

6.4.1.2 City and County of San Francisco neighbourhoods

Miraloma Park has the highest median household income level in San Francisco, well above the city's median household income. In contrast, Bayview's and Chinatown's median household income levels are well below the city's median, with both neighbourhoods having a high percentage of low-income

residents. Demographically, Miraloma Park's residents are mostly White. Bayview is comprised of mostly ethnic and racial minorities and has the highest percentage of Black residents than any other neighbourhood in the city. Chinatown consists of mostly ethnic Chinese. A summary of selected demographic characteristics of study sites is listed in Table 6.2.

Table 6.2 *Demographics of Miraloma Park, Bayview, Chinatown, and the City and County of San Francisco*

	Pop.	% Pop Below Poverty Level	Median HH Income (USD)	Race and Ethnicity (top three)		
Miraloma Park	4,849	6%	$121,151	White (57.6%)	Asian (25.2%)	Latino (9.8%)
Bayview	35,201	23.5%	$49,594	Asian (32.9%)	Black (32.8%)	Latino (21.7%)
Chinatown	9,998	32%	$18,368	Asian (80.9%)	White (12.36%)	Latino (3.7%)
City and County of San Francisco	829,092	13.3%	$78,378	White (41.4%)	Asian (33.3%)	Latino (15.3%)

Note. From San Francisco Planning Department (2012), and U.S. Census Bureau (2014).

6.4.2 Participant recruitment

To ensure representative perspectives on neighbourhood values and disaster resilience, the authors recruited participants both with and without emergency management experiences, including participation in neighbourhood response trainings and planning meetings, and voluntary or paid experience within the emergency management sector. While participants with emergency management experiences provided insights into existing levels of preparedness and response capacities of their neighbourhoods, the recruitment of participants without such experiences aided in the exploration of contextual influences that affected people's lack of emergency preparedness knowledge. To identify participants, the authors partnered with government agency representatives, community-based organisations (CBOs), and community leaders, and posted flyers and social media messages in neighbourhood bulletins. Nine focus groups totalling 58 participants were conducted between March 2016 and October 2016. Participants either lived or worked full-time in a study site and were at least 18 years of age. Table 6.3 summarises participants' characteristics and recruitment methods.

Table 6.3 *Participants' background, gender, and recruitment methods*

Neighbourhood	No. of focus groups	EM Experience		Status*		Gender		Recruitment method
		With EM training/ planning	*Without* EM training/ planning	Live	Work	Women	Men	
Brooklyn (NZ)	2	9	6	15	3	6	9	Government agency, flyers, social media, community leaders
Cannons Creek (NZ)	2	1	11	10	7	10	2	CBO representatives, flyers, community leaders
Miraloma Park (US)	1	8	0	8	1	5	3	Community leaders
Bayview (US)	3	6	8	12	2	9	5	Government agency, CBOs representatives, flyers, community leaders
Chinatown (US)	1	4	5	0**	8	5	4	CBO representatives, community leaders
Total	9	28	30			35	23	

*Some participants live and work full-time in the neighbourhood and are listed in both columns.
**A participant in the Chinatown focus group is a non-resident client of a community-based organisation.

6.4.3 Development of focus group questions

In formulating the focus group questions, the authors adapted questions from two research studies. The first study was a workshop that sought to identify core social resilience characteristics (Table 6.4) through the perspectives of hazards researchers, emergency management practitioners, and policymakers in the Wellington region (Kwok et al., 2016). In that workshop, social resilience was framed as comprising four categories of neighbourhood resources and processes (Kwok et al., 2016):

- Skills, abilities and knowledge
- Qualities and amenities
- Values and beliefs
- Community processes

Table 6.4 *Core attributes of social resilience of communities from the perspectives of researchers, policymakers, and practitioners*

Cognitive dimension of social resilience (attitudes, values, and beliefs of individuals about themselves and their environment)	**Structural dimension of social resilience** (discrete features and characteristics of a social entity such as people and communities)
Adaptability – ability to embrace change Collective efficacy Community inclusiveness Connectedness between networks Leadership Sense of community and attachment Shared community beliefs and values Social support Trust	Access to economic resources Community (and individual) preparedness Democratic and collaborative decision-making and problem-solving policies and processes Disaster management planning Diversity of skills and training Knowledge of community assets and beliefs Knowledge of risks and hazard consequences Robust community spaces and amenities Social networks

Note. From "What is 'social resilience'? Perspectives of disaster researchers, emergency management practitioners, and policymakers in New Zealand", by A. H. Kwok, E. E. H. Doyle, J. Becker, D. Johnston, and D. Paton, 2016, *International Journal of Disaster Risk Reduction, 19*, pp. 197-211.

This study integrated the framing of social resilience with the second study conducted by Freitag et al. (2014), who used an asset-based appreciative inquiry (AI) approach to elicit people's perspectives on community disaster resilience. AI seeks to explore ideas, values, and perceptions that people have about their environment by focusing on positives rather than on problems (Reed, 2007). Their study first asked research participants to respond to questions such as "What do they like about their community?" and "What makes their community unique?" to help identify local assets that promote individual and community wellbeing (Freitag et al., 2014, p. 325). This was followed by a discussion about the resources required for community preparedness, response, and recovery (Freitag et al., 2014).

By integrating the questions and approaches used in these two earlier studies, this study sought to identify common and contextual disaster resilience themes by asking participants the following questions: *How would you describe your neighbourhood? What are your favourite things or places in the neighbourhood? When you hear the phrase 'community disaster resilience', what do you think of? What does your neighbourhood need (e.g., skills, abilities, knowledge, resources, values and beliefs, and community processes) in order to anticipate, cope with, and overcome the challenges and changes from a disaster, such as an earthquake?*

Using the qualitative data analysis principles set out by Braun and Clark (2006), responses to these questions were audio-taped, transcribed, coded, and analysed by their themes.

6.5 Results

6.5.1 What do neighbourhood stakeholders consider as important in their communities?

Participants' responses suggest that their community values are rooted in the identities and socio-cultural norms of their neighbourhoods.

Neighbourhood identities

Many factors influenced how participants framed the identities of their neighbourhoods, but a dominant contributor to the formation of neighbourhood identities is a neighbourhood's history. Participants with long residential tenure were able to provide a degree of historical continuity by recounting the changes (e.g., demographic changes) that had occurred in their neighbourhoods. Although they attributed much of the neighbourhood changes to external influences, the legacy of historical identities of these neighbourhoods continues to the present day.

While participants took pride in their neighbourhoods' positive identities, they actively rebuked (or

reframed) those with negative connotations. For example, in Cannons Creek and Bayview, which were beset by high rates of crime in the past, participants felt that the lingering reputation of their neighbourhoods as high-crime, dysfunctional places masked the existing community strengths (e.g., strong social bonds between residents) that contribute to their neighbourhoods' disaster resilience.

Neighbourhood identities are also reflected in existing neighbourhood amenities and features, which participants from all focus groups pointed to as a source of community pride. Local parks, retail shops, food establishments, recreational facilities, neighbourhood-wide events, and schools provide opportunities for everyday interactions and cultivate a sense of shared experiences among residents. For instance, participants recounted their neighbourhood coming together in advocating for the development of certain amenities (e.g., community gardens) or exclusion of unwanted ones (e.g., liquor stores). These collective actions have served to solidify a sense of community and community attachment, factors that contribute to neighbourhood resilience (Chamlee-Wright & Storr, 2009b)

Socio-cultural norms of neighbourhoods

Participants voiced the importance of 'knowing your neighbours' as essential to maintaining a sense of community and disaster resiliency. Regardless of a neighbourhood's socioeconomic level, participants' responses demonstrate that each neighbourhood examined has a high degree of social connectedness. That connectedness is reinforced by different social and cultural infrastructures in each neighbourhood: churches in Cannons Creek; cultural networks and community-based organisations in Bayview; the residents' association in Miraloma Park; community-based organisations and cultural homogeneity in Chinatown; and community-based groups and schools in Brooklyn.

Yet, focus group discussions highlighted the fragility of these social norms, which can be enhanced or depleted by neighbourhood changes over time. Bayview (San Francisco) provides the starkest example. Participants discussed at length their feelings on the loss of community among African-Americans residents and other low-income community members because many have relocated elsewhere due to the rising cost of living and encroaching gentrification. Although many felt that the neighbourhood is still close-knit, the rapid changes in neighbourhood demographics are eroding place-based social bonds and social support that had been built over decades.

6.5.2 How is 'community disaster resilience' defined by neighbourhood stakeholders?

The phrase *community disaster resilience* elicited a wide range of responses among participants. The aggregated responses were coded and categorised based on the following resilience aspects: scales of resilience, resilience of whom, resilience to what, and resilience outcomes (Table 6.5).

Table 6.5 *Focus group participants' definition of 'community disaster resilience' (aggregated responses from all focus groups)*

Resilience aspects	Themes
Scales of resilience	Levels – individual, household, community, society Spatial – proximity between neighbourhoods and to hazards Temporal – preparedness, response, recovery
Resilience of whom?	Neighbourhood/community Diverse groups
Resilience to what?	Internal and external stresses – both human-induced and natural hazards
Resilience processes	Adapting (to change); bouncing back; coming together; coping; reframing expectations (e.g., receiving external assistance); striving; surviving; withstanding/resisting adversity
Resilience outcomes	Residents benefitted from changes Maintenance of psychological and physical health and wellbeing Reduction in everyday vulnerabilities of people (e.g., homelessness) Retention of residents Resumption and sustainability of community functions

The diverse views of these participants mirror existing definitional debates on *community disaster resilience* in the literature. However, it is important to note that the term *resilience* was not a universally understood concept. Many participants without emergency management knowledge and from the Chinatown focus group did not understand what 'resilience' meant and required further clarification. For participants who did not understand the phrase, the term *resilience* was replaced with *community strengths*, a phrase that aligns with this study's framing of the concept (see Section 6.4.3.). While responses to the alternative phrase were found not to be markedly different, the authors recognise participants' responses could have supplanted other perspectives if they had fully understood the term 'resilience'. To maximise community input in disaster resilience planning, this issue highlights the need for translating 'resilience' and its conceptual meanings into appropriate cultural and linguistic contexts of community members (IFRC, 2016).

6.5.3 What do neighbourhood stakeholders think their communities need to cope with a natural hazard event?

In identifying characteristics of neighbourhood resilience, and in particular social resilience, this section discusses participants' responses relating to the following areas: a) skills, abilities, and knowledge; b) qualities and amenities; c) values and perceptions; and d) community processes (see Section 6.4.3.) Although focus group questions were geared toward identifying the characteristics of

social resilience, a range of responses necessitates that the identified characteristics be categorised into different resilience domains. These characteristics are coded into five broad areas: individual/psychological, socio-cultural, economic, infrastructural/built, and institutional/governance. By synthesising participants' responses to this question and those relating to sections 6.5.1. and 6.5.2., Table 6.6 lists the resilience characteristics that were identified to be essential to neighbourhood resilience, along with a description, participant's quote, and supporting literature reference(s) for each theme.

The themes in this list serve as a foundation for measuring both tangible and intangible components of disaster resilience at the neighbourhood level. These include people's values and beliefs as well as neighbourhoods' assets and capacities. Many of these themes are similar to those stated by emergency practitioners, policymakers, and researchers – individuals who are considered as DRR *experts* but may not be embedded within the communities they serve (see Table 6.4). The consistency of responses between DRR experts and focus group participants suggests that neighbourhood stakeholders are not only aware of the resilience assets and gaps in their communities, but that they can also provide contextual insights into neighbourhood conditions and processes that could be valuable in DRR planning. Hence, local stakeholders and practitioners should adopt tools such as the urban context analysis (International Rescue Committee, 2017) to help generate contextual information that aids in the collaborative process of assessing resilience and designing neighbourhood-specific interventions.

While the themes in Table 6.6 are based on the findings of focus groups from the study sites, the authors caution readers in applying these resilience measurement themes to other communities. Rather, this paper emphasises the need for a bottom-up approach to developing a disaster resilience measurement framework that reflects place-specific values and perspectives. Additionally, this research process highlights several challenges and considerations for neighbourhood stakeholders and government agencies seeking to collaboratively develop neighbourhood-based disaster resilience assessment tools.

Table 6.6 *Disaster resilience themes for measuring resilience of urban neighbourhoods*

Category	Theme – neighbourhood resilience	Description	In the words of participants	Reference
Individual/ psychological	Individual responsibility	Personal responsibility for self-protection (e.g., disaster preparedness)	'Make people … as robust as possible so they can survive without anybody. Nobody is going to come help you, if you have no food in your house, you gonna go hungry.'	Becker et al. 2015
	Psychological well-being	Pre-existing and post-disaster mental and emotional health of individuals	'Do they have symptoms of traumatic stress? It's that kind of stuff that's really complex. And that's stuff that get missed off, cause it's not on the surface.'	Paton, Mamula-Seadon, et al., 2013
	Self-efficacy	An individual's belief that s/he can do something to control the outcome of a disaster	'If there's trouble in front of my place, I'd go out and address it. And that makes it safe for the old and the young to come out of their houses and say hello.'	Becker et al. 2015
Socio-cultural	Awareness of hazard risks	Awareness of natural hazards that exist in the neighbourhood	'Definitely flooding. If there's a storm, it [the creek] will flood – almost every year.'	Becker et al. 2015
	Awareness of vulnerabilities of people and structures	Knowledge of people who might need assistance and of buildings/structures that might be at risk in a disaster	'The biggest community that would be affected … by a major earthquake would be the council flats at the bottom of the hill. And there are whole floors of people who don't speak English.'	Becker et al. 2015
	Collective efficacy	The belief that a community can do something to control the outcome of a disaster	'What you need is a support network, if they are already active. If people are already doing things, then [in] emergencies [it is] much easier to make things happen.'	Paton, Mamula-Seadon, et al., 2013
	Community participation	People's participation in community groups and events that enhance their social networks and connections	'Like our NERT program and the Miraloma Park Improvement Club … The more people that you have that get active or even knows about things leads to resilience. It's not something that happens overnight. It's an ongoing process.'	Becker et al., 2015; Sherrieb et al., 2010
	Cultural values and practices	Cultural values, beliefs, practices of individuals and groups that enhance their resilience	'I think with that extended family and especially amongst the African-American … it is a family – it has the same family support [than a nuclear family structure].'	Chamlee-Wright and Storr, 2010
	Education and training	Knowledge needed and how people can gain such knowledge in preparing for and responding to disasters	'They tell you to keep batteries in your house, flashlight, water, you have to keep some canned goods or some type of food … And once we have those [preparedness training] sessions and they let us know what we need to do in case of an earthquake, we'd be better prepared.'	Paton, 2013
	Information and communication	Availability and accessibility of disaster risk information and the mechanisms that aid in the dissemination of such information	'So people just need to have the information in whatever capacity, whether it's through the schools, the kapi-mana [newspaper]. But it needs to be on a regular basis.'	Norris et al., 2008

	Learning from past hazard events (locally or elsewhere)	Past experiences – both disasters and other adverse events	'There's a lot of lessons were learned from that [flooding] event, cause a lot of people were affected by it.'	Becker et al. 2015
	Place attachment	The degree of people's emotional investment in their neighbourhood that increases their motivation to protect that investment	'I think also homeowners are, they don't all, they're more likely to have children. Renters do as well. I think … when people got children they become a lot more cemented because they are using the facilities.'	Becker et al., 2015; Norris et al., 2008
	Diversity of skills	People in the neighbourhood with the necessary skillsets to meet the diverse demands arising from a disaster	'You might have a register: Who could fix houses, people who have access to plumbing, plumbers and engineers. But then, social workers, or someone who could go walk some old lady's dog or volunteer networks.'	Paton, Mamula-Seadon, et al., 2013
	Social networks	Social connections between individuals and groups	'I think we could get to know our neighbours better and also the people who don't live in our community, so opportunities to get to know the people … in different contexts as an opportunity to build that resilience.'	Aldrich, 2012a
	Social responsibility	Responsibility to assist others in or outside of the neighbourhood, including social support	'Resilience is based on community and neighbours knowing one another other, learning how to take care of one another.'	Paton, Mamula-Seadon, et al., 2013
	Stability of population	Length of residence in the neighbourhood	'There are many people who've been here for many, many years … till now, there's been a pretty low turnover. People have roots going back.'	Sherrieb et al., 2010
	Understanding potential hazard impacts and consequences	Ability to anticipate potential disaster impacts on people and the neighbourhood	'It could be ten days, two weeks, till there's actually some reliable supply other than fresh water coming in.'	Becker et al. 2015
Economic	Economic resilience of individuals and communities	Financial health of individuals, households, and the neighbourhood	'I think poverty comes in as well. A lot people, they are scraping by as it is, they don't have the money to have food stored up, and generators. There's where the resources are lower than wealthier neighbourhoods.'	Sherrieb et al., 2010
Infrastructural/ built	Neighbourhood space and amenities	Places and services that support individual, household, and community functions	'I would want to be at the pub when the earthquake occurs because we've developed quite a community there.'	Chamlee-Wright & Storr, 2009b
	Structural integrity of buildings and infrastructure (e.g., roads) and lifelines	The ability of buildings, infrastructure and lifelines to survive disaster impacts and maintain their functions	'Those basic things like being able to flick on electricity, and the tap to get water, and to flush the toilet, or to drive down the road to pick up a cell phone or whatever or communicate with somebody.'	Cutter et al., 2014
Institutional/ governance	Civic infrastructure	Networks of CBOs and agencies	'You need those [social services] organisations and those who people can recognize.'	Graham et al., 2016

	Experiences and effectiveness in collective action	Past experiences and effectiveness in people coming together to solve community problems	'We've had a few protests then. When that happened, as a community, we all stepped up and we all marched together, and we are all like one group.'	Graham et al., 2016
	Unifying leadership	Leaders or organisations who represent the interests of the neighbourhood	'I think it's really important is that in order for a neighbourhood to have a voice and be heard by either an elected official … we need to have some sort of a group that speaks for more than just one person.'	Paton, Mamula-Seadon, et al., 2013
	Inclusiveness	Inclusion of diverse stakeholders and views in community planning process	'We are the last ones to know of or be in on anything in any information. It's hard to get information … we are the last ones to know.'	Paton, Mamula-Seadon, et al., 2013
	Community planning	The presence of disaster plans within the neighbourhood	'There are temporary plans for individuals who don't have housing or who are unable to go back to their apartments. There'll be shelter locations available and there's going to be account for having more people we can put here temporarily.'	Becker et al. 2015

6.6 Challenges and considerations

Community engagement issues

While community engagement has been advocated in community-based DRR planning (Horney et al., 2016; Pfefferbaum et al., 2015), this and other studies (e.g., Vallance, 2014) point to a disconnect between the rhetoric of community engagement and challenges in engaging representative segments of a neighbourhood in the field. For example, a significant shortcoming in this study was the lack of involvement from several key stakeholder groups, especially the business community, non-English speakers, and certain ethnic minority groups. Although resilience themes in this qualitative study reached saturation (Fusch & Ness, 2015), factors such as timing, language accessibility, location, salience of the research topic and relevance of focus groups could have created unintentional barriers for participation.

Due to time and financial resource constraints experienced by practitioners and community-based agencies, achieving full community engagement may not be possible. Thus, the goal of community engagement may not have to include everyone, but rather to identify and work with the more vulnerable and disempowered groups in developing strategies for community development, mentoring, and advocacy as part of the capacity-building and DRR planning process. This is especially important as vulnerable populations are often the least able to participate in local planning (Horney et al., 2016). Community engagement strategies also need to reduce other engagement barriers such as those relating to terminologies and languages, gender, income, disabilities, and stakeholders' cultural beliefs and values (IFRC, 2014). Although Table 6.6 describes resilience measurement themes that are shared across the study sites, the perspectives stemming from stakeholders from other diverse backgrounds and experiences could help refine these themes for each neighbourhood.

Scaling issues

Another challenge in formulating neighbourhood-based measurements is that neighbourhoods do not exist in a vacuum. As resilience is conceptualised as existing across different societal domains and spatial scales, a systems approach to assessing resilience that takes into account linkages of resilient capacities, disaster risks, and societal vulnerabilities becomes necessary (Cavallo & Ireland, 2014). A drawback in developing neighbourhood-level measures is the inherent challenge of accounting for external influences that, on most occasions, are dictated by city- or regional-level policies enacted at levels beyond the purview of neighbourhood governance.

Therefore, neighbourhood-based measures need to reflect conditions and processes that are amenable to change through community development, engagement and empowerment programmes. Especially when many of these neighbourhood-based programmes are carried out for a short period of time, it is essential to assess neighbourhood conditions and determine realistic performance expectations and metrics. For instance, resilience measures that are focused on social capital need to decipher which aspects of the concept are amendable to change by neighbourhood-based interventions. Furthermore, neighbourhood-based assessments need to consider for potential cascading effects that are beyond the control of neighbourhoods (e.g., influx of displaced residents from neighbouring communities and relocation of employment opportunities). Thus, the authors advocate for having a multi-scalar assessment that links the effects of resilience policies and interventions at multiple societal levels while incorporating the values and needs of neighbourhood stakeholders.

In summary, this study addressed how neighbourhood stakeholders conceptualise social resilience of disasters. Their community values point to the importance of neighbourhood identities, amenities, and socio-cultural norms in contributing to community disaster resilience. Their perspectives also reveal their understanding of the individual/psychological, socio-cultural, economic, infrastructural/built, and infrastructural/governance dimensions of resilience. Rather than applying the identified resilience themes to other localities (as they might not be applicable), this study highlights the importance of using bottom-up methods, such as those described in this paper, as imperative to the identification of resilience measures that reflect local values and priorities. While recognising challenges such as engaging the whole-of-community and accounting for structural influences that are external to neighbourhood governance, the authors believe that this study's approach could help advance the call for sharing DRR responsibilities between governments and communities by cultivating the "commitment, goodwill, knowledge, experience, and resources" between them (UNISDR, 2015b, p. 23).

6.7 Link to Chapter 7 – Paper 3

As discussed in this chapter, the perspectives of neighbourhood stakeholders in focus groups shared several similarities with those of experts (i.e., hazard researchers, emergency management practitioners, and a policymaker) in the workshop (Chapter 5, Kwok et al., 2016). The similarities in the conceptualisation of social resilience by different stakeholder groups point to opportunities for operationalising the concept within the context of resilience measurements. Since it is beyond the scope of this thesis and exceeds the allocated research resources (e.g., finances and time) to develop specific measures for each of the resilience themes identified in this chapter and in Chapter 5, the

next chapter (Chapter 7 – Paper 3, Kwok, Becker, et al., 2018) addresses social capital, a component of social resilience, that both stakeholder groups (i.e., experts and neighbourhood stakeholders) believed to be essential to community disaster resilience.

As discussed in Section 2.3.3, social capital is an essential resource that facilitates individual and community preparedness, response, and recovery. However, not everyone, especially vulnerable populations, benefits from social capital. Because researchers and policy makers have been pushing for cultivating neighbourhood-based social capital as a way to increase neighbourhood resilience, understanding what social capital means for neighbourhood stakeholders and how their perspectives can inform its measurement is an important step towards developing appropriate resilience interventions.

Drawing on the literature and focus group data (as part of research project #2; refer to Section 3.3), Chapter 7 describes how social capital is conceptualised within the literature and by neighbourhood stakeholders and discusses three key themes that influence the formation, activation, and benefits of social capital resources. These three key themes provide guidance for the development of an integrated social capital measurement framework that combines qualitative and quantitative measures for assessing structural and cognitive levels of social capital in neighbourhoods. The social capital assessment framework provides a basis for the development of specific measures that reflect neighbourhood-specific conditions and dynamics, with consideration for measuring community engagement and cross-scaled linkages.

Chapter 7 – Paper 3: Stakeholders' perspectives of social capital in informing the development of neighbourhood-based disaster resilience measurements

Authors

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Abstract

The cultivation of neighbourhood-based social capital has gained significant attention in the disaster management sector in recent years as a means to increase community disaster resilience. However, within the sector, the concept of social capital remains unclear and its measurement is limited at the neighbourhood level due to a focus on predominately top-down and quantitative approaches. By using a qualitative, inductive-driven approach, this paper proposes an integrated social capital measurement framework that combines qualitative and quantitative measures for evaluating levels of social capital in neighbourhoods. Nine focus groups consisting of 58 participants across a range of socioeconomically and ethnically diverse urban neighbourhoods in New Zealand and the U.S. were conducted. Three key themes were identified that relate to the formation, activation, and benefits of social capital resources: community demography, cultural influences on social support, and neighbourhood governance. By synthesising the study's results and existing literature, the study's proposed framework incorporates both quantitative indicators and contextual questions across six structural and four cognitive social capital domains.

7.1 Introduction

A growing emphasis in policy, research, and practice on building community disaster resilience over the past two decades has spawned a proliferation of community disaster resilience assessments and tools (Cutter, 2016; IFRC, 2016; Ostadtaghizadeh et al., 2015; Sharifi, 2016). Increasingly, these assessments highlight the importance of enhancing the resilience of the social environment, or

'social resilience,' and complementing this with other physical or built mitigation measures as a means to enhance communities' readiness for future hazard events (National Institute of Standards and Technology, 2015). Social capital, a component of social resilience, has been highlighted by researchers, policymakers, practitioners, and neighbourhood stakeholders as a key way to increase the resilience of individuals and communities (Kwok et al., 2016; Kwok, Paton, et al., 2018). Despite decades of research on the conceptualisation and measurements of social capital, there remains a need within the disaster management sector to clarify what social capital is and how it can be measured (Australian Red Cross, 2012). Existing conceptualisations of social capital are discussed in Section 7.2.

Lessons from past disasters such as the Kobe earthquake in Japan, Hurricane Katrina in the U.S. Gulf Coast, Hurricane Sandy in the eastern U.S., and the Christchurch earthquakes in New Zealand reveal the important roles that social capital played in facilitating community disaster and recovery (Aldrich, 2012b; Elliott et al., 2010; Nakagawa & Shaw, 2004; Paton et al., 2014; The Associated Press-NORC Center for Public Affairs Research, 2014). These experiences illustrate how people, organisations, and communities actively invest in and activate social capital in order to procure necessary resources for disaster response and recovery and to plan for future natural hazard events. The potential benefits of social capital have propelled non-governmental agencies (e.g., Australian Red Cross, 2012; Herbst & Yannacci, 2013) and local governments (e.g., City and County of San Francisco, 2016a; Wellington City Council, 2017) to develop interventions that seek to increase the levels of social capital in communities that are at risk of such events.

The development and implementation of interventions comes with the need for developing metrics that serve to baseline existing levels of resilience, evaluate the effectiveness of interventions, and track progress toward desired resilience goals (Committee on Increasing National Resilience, 2012). This paper offers a novel approach to baselining social capital and evaluating progress toward increased social capital levels of local communities by using an integrated assessment framework. It derives a set of quantitative and qualitative measures by drawing on the contributions of diverse neighbourhood stakeholders who are seen as being on the front-line of disaster preparedness and response (Gaillard & Mercer, 2013). This approach moves the rhetoric of social capital and community disaster resilience to actionable collective strategies that reflect the different needs and priorities of individual neighbourhoods.

This paper reports findings on focus group discussions with stakeholders from five neighbourhoods in New Zealand and the U.S. While the topic of the focus groups centred on social resilience, a recurring theme in the discussions pertained to the perceived importance of social capital. As such,

this paper presents the authors' analysis of participants' framing of social capital and the development of disaster resilience-related social capital measurements.

7.1.1 Rationale for identifying social capital measures within the context of disaster resilience

Despite extensive research on the conceptualisation and measurements of social capital, there remains confusion within the disaster management sector over what social capital is and how best to measure it (Australian Red Cross, 2012). Predominately, resilience assessments benchmark and evaluate social capital through a positivistic lens, which results in two challenges. The first challenge is the omission of a consideration of contextual influences on social capital levels within a standardised, quantitative-based approach (e.g., Sherrieb et al., 2010). Such an approach overlooks local values, dynamics, and conditions that could have facilitated or hindered the development and manifestation of social capital resources (Mohan & Mohan, 2002). As will be discussed in Section 7.4, social capital is a place-based and context-specific resource (Mohan & Mohan, 2002). Consequently, reliance on standardised indicators for policy and programme development could impair the responsiveness of interventions to local conditions and their effectiveness in achieving intended objectives.

Encouragingly, this problem is beginning to be addressed through qualitative studies that explore how social capital unfolds in a disaster environment; these studies point to the contextual influences relating to racial, cultural, gender, rural/urban and livelihood factors (Chamlee-Wright & Storr, 2009b; Cox & Perry, 2011; Ganapati, 2012; Graham et al., 2016; LaLone, 2012). While these studies seek to identify contextual influences of social capital in a disaster environment, they do not (and are not intended to) derive resilience measures from their findings. Thus, more research is needed to ground resilience assessment and evaluation measurements through contextual findings.

The second challenge is that, while social capital measures are quite mature in the literature, their application within the context of disaster risk reduction remains nascent. As a result, established measures may not apply to disaster contexts. For instance, practitioners at the Australian National Disaster Resilience Roundtable (Australian Red Cross, 2012) stressed the importance of developing measures that are fit-for-purpose instead of using generic standard social capital assessments:

> In order to gauge the strength of social capital in communities, it is recommended that a number of simple indicators be chosen to help with targeting and planning activities. These indicators should be easy to use, universal and need to be applied in a way that does not require complex analysis. Consideration should be given to indicators that relate to disaster resilience (p. 5).

This challenge creates an opportunity to develop social capital measures that can identify barriers to and opportunities for disaster preparedness, response, and recovery.

To address these two challenges of considering contextual influences on social capital and applying them to disaster contexts, this study used an inductive, qualitative-driven approach to examine the conceptualisation of social capital by stakeholders from five communities in New Zealand and the U.S. that are at risk of future seismic events, finding recurring themes that form the basis of social capital measures applicable across study neighbourhoods.

This paper first provides an overview of the conceptualisation and framing of social capital, as well as how the concept is measured within the disaster literature (Section 7.2). It is followed by discussions on the study's methodology (Section 7.3). Results of the study are presented in Section 7.4, which includes a discussion of three social capital themes: community demography, cultural influences on social support, and neighbourhood governance. In Section 7.5, through a synthesis of the literature and this study's results, a proposed set of indicators and contextual questions for assessing neighbourhood-based levels of social capital is presented. This paper concludes with the study's limitations and future research directions.

7.2 Literature on social capital

7.2.1 Framing social capital

For decades, researchers outside the disaster management field have sought to examine social capital as a means to understand various social issues, including family and youth problems, education, community life, work and organisation, democracy and governance, and development issues (Woolcock 1998, footnote 20). As a concept, social capital is integral to many government policies and community programmes that aim to facilitate desired societal outcomes (Lelieveldt, 2008; Putnam, 2000; Woolcock & Narayan, 2000). While researchers have come up with a range of conceptualisations of social capital, most agree that social capital exists within social relationships or social networks (Castiglione, Van Deth, & Wolleb, 2008; Lin, 2008). Lin (2008) defines social capital as "resources embedded in one's social networks, resources that can be accessed or mobilized through ties in the networks" (p. 15).

A conceptualisation of social capital distinguishes social capital by its features, sources (or inputs), or benefits (or outputs) (Castiglione et al., 2008; Grootaert & van Bastelaer, 2001). Putnam (1995) describes the features of social capital as including social networks, social norms, and social trust. Sources of social capital include mechanisms such as obligations and expectations, information

channels, and social norms within social structures that could either facilitate or constrain the development of social capital (Coleman, 1988). Putnam (1995) conceives that civic engagement fosters norms of generalised reciprocity and encourages the emergence of social trust, both of which form the foundation for collective action (an output) by promoting coordination and communication between individuals and groups in resolving societal challenges.

Another conceptualisation revolves around two dimensions: its scope (micro, meso, and macro) and forms (structural and cognitive) (Grootaert & van Bastelaer, 2001) (Figure 7.1).

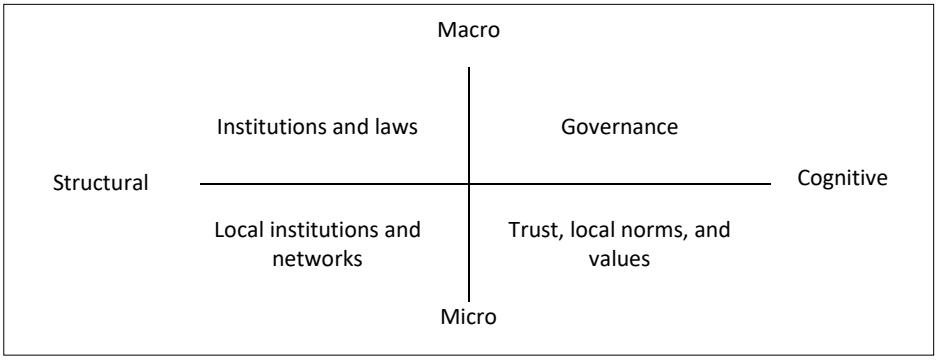

Figure 7.1 Scope and forms of social capital. Reprinted from *Understanding and measuring social capital: A synthesis of findings and recommendations from the social capital initiative*, by C. Grootaert and T. van Bastelaer, 2001, p. 20.

The scope of social capital refers to whether its resources are located at the level of household or community (micro), city or region (meso), or nation (macro) (Grootaert & van Bastelaer, 2001). Structural social capital consists of established patterns of behaviours such as roles, rules, and procedures within social organisations and networks. Cognitive social capital deals with civic culture, which comprises characteristics such as norms, values, attitudes, and beliefs that are informed by culture and ideology (Uphoff, 1999). Together, structural and cognitive social capitals form the basis for collective actions that generate benefits for the collective whole (Uphoff, 1999). Table 7.1 describes the sources and manifestations of structural and cognitive dimensions of social capital, as well as their domains and common elements.

Table 7.1 *Structural and cognitive dimensions and characteristics of social capital*

	Structural	**Cognitive**
Sources and manifestations	Roles and rules Networks and other interpersonal relationships Procedures and precedents	Norms Values Attitudes Beliefs
Domains	Social organisation	Civic culture
Common elements	Expectations that lead to cooperative behaviour or action, which produce mutual benefits	

Note. From "Understanding social capital: Learning from the analysis and experience of participation", by N. Uphoff, 1999, *Social capital: A multifaceted perspective*, p. 215-249.

Since social relationships or social networks are a key component of social capital, a dominant conceptualisation of social capital focuses on the three types of relational associations: bonding social capital, bridging social capital, and linking social capital (Woolcock & Narayan, 2000). Bonding social capital is characterised by relationships of similarity such as family friends, neighbours, and people with shared interests and beliefs (Aldrich, 2012a; Putnam, 2000; Woolcock, 2002). Because of their strong identities and sense of belonging, bonding social capital is more "inward looking and tend[s] to reinforce exclusive identities" but is "good for undergirding specific reciprocity and mobilizing solidarity" such as fulfilling members' psychosocial and financial needs (Putnam, 2000, p. 22). Bridging social capital comprises "relations of respect and mutuality" between people from different networks, differentiated by factors such as socioeconomics, social identity, religious beliefs, age, ethnic group, or location of residences (Szreter and Woolcock, 2004, p. 655). While bonding and bridging relationships are horizontal in nature in which members share similar power differentials, bridging networks are more outward looking, serve as links to external assets, and are used for information diffusion (Putnam, 2000; Szreter & Woolcock, 2004). Linking social capital differs from the other two types as it consists of relational networks in which people "interact across explicit, formal or institutionalized power or authority gradients in society" (Szreter and Woolcock 2004, p. 655). These are vertical relationships of differing power differentials based on mutual respect and trust, and are developed with the intent to achieve mutually beneficial objectives (Szreter, 2002). Linking networks may include a variety of groups that hold decision-making and resource allocation power.

These three distinct strands of social capital conceptualisations have been used to operationalise how social capital is examined within disaster resilience literature, which is discussed next.

7.2.2 Social capital and disaster resilience

In alignment with existing conceptualisations of resilience, this paper describes resilience as an adaptive capacity (Becker et al., 2013; Berkes, 2007; Klein et al., 2003; Norris et al., 2008; Paton, 2006a). Adaptive capacity is the ability of communities to identify and procure resources and competencies so they can prepare for external stressors and appropriately respond to the consequences caused by the stressors (Engle, 2011). Increasing adaptive capacity allows a community to improve how it manages and meets the unpredictable demands that arise from a natural hazard event and attains functionality in a new post-disaster environment (Paton & Johnston, 2017). The role that social capital plays in increasing adaptive capacities of individuals and communities in disasters has received significant attention recently as a variety of disaster-related

outcomes have been linked to the activation of the resources embedded within both informal and formal social networks.

A large body of research illustrates that community-based informal and formal networks serve to catalyse protective, response, and recovery actions such as preparing for disasters and mitigating hazard risks (Bihari & Ryan, 2012); sharing disaster preparedness information at the individual and household levels (Becker et al., 2012; Becker, Paton, Johnston, Ronan, & McClure, 2017); making official government warnings more credible, especially when there is pre-existing distrust between community members and their governments (Litt, 2008); assisting with the timely evacuation of friends, families, and neighbours (Hawkins & Maurer, 2009; Litt, 2008); responding to disaster impacts such as injuries and fires (Nakagawa & Shaw, 2004); providing immediate disaster relief services and supplies (Feuer, 2012; Hayward, 2013); and planning for long-term disaster recovery through collective decision-making and collective action (Adger, 2003; Bolin & Stanford, 2006; Graham et al., 2016; Montgomery, 2013; Nakagawa & Shaw, 2004). Furthermore, social capital has been linked to the promotion of other forms of capital within the context of natural hazard events, such as cultivating leadership skills (human capital) (Becker et al., 2012), enhancing the financial wellbeing of individuals and households (financial capital) (Shimada, 2014), improving community governance and planning coordination (political capital) (Aldrich, 2012a), and protecting ecological services (natural capital) (Adger, Hughes, et al., 2005).

While social capital is essential to effective disaster management efforts, people who are not part of a network may be excluded from collective benefits, as seen in various disaster response and recovery activities (Aldrich, 2011a; Aldrich & Crook, 2008; Ganapati, 2013). For instance, vulnerable populations (e.g., the elderly, women, and minority groups) in India were found to be excluded from aid in post-tsunami southeast Asia as they could not gain access to organisations that distributed it. In post-Katrina New Orleans, displaced residents without the financial resources to relocate or rebuild were further marginalised when neighbourhoods with strong social infrastructure prevented the placement of 'undesirable' housing trailers that sought to shelter them (Aldrich & Crook, 2008). Recognising how social capital can facilitate and impede disaster resilience is key to its assessment.

7.2.2.1 Social capital as a place-based resource

One of the connecting threads of the research referenced above is the spatial aspect of social capital. Although it could be argued that people's social relationships can be based on shared interests that are irrespective of geographical locations, much of social capital within the context of disasters is proximal and is shaped by the character and context of places (Hawkins & Maurer, 2009; Mohan & Mohan, 2002; Murphy, 2007). For example, the socioeconomic context of a women's

social network in an African-American community (e.g., daily interactions through reciprocal assistance in childcare and job referrals) contributed to their effective evacuation response prior to the landfall of Hurricane Katrina (Litt, 2008). Bonding social capital such as the women's network is vital to low-income and marginalised groups, especially in the absence of government support and services (Adger, 2003). In a second instance, LaLone (2012) examined the mobilisation of social capital of rural Appalachian communities after the landfall of tornadoes. The setting of her research reveals that the long-standing social norm of generalised reciprocity – the exchange of goods and services without an expectation of immediate pay back – in families and among neighbours has been shaped by the historically coal-mining and farming industries as means to buffer against fluctuations of employment in those industries (LaLone, 2012). Documented patterns of reciprocity are essential to successful early disaster response (LaLone, 2012). These examples highlight that the activation of social networks in a disaster situation is confined, at least initially, within a narrowly defined area such as a neighbourhood, even in hazard events that span a large geographic area (Murphy, 2007).

Because social capital is largely a place-based phenomenon that is shaped by various contextual influences, this paper focuses on the conceptualisation of social capital at the neighbourhood (micro) level. As neighbourhoods are at the frontline in preparing for as well as dealing with the aftermath of disasters, the neighbourhood scale of analysis offers unique opportunities for examining how people invest in the development and mobilisation of social capital resources to adapt to potential natural hazard events.

7.2.3. Measuring social capital within the context of disaster resilience

The varied conceptualisations of social capital in social research have resulted in a wide array of measurement approaches ranging from quantitative to qualitative measures, from macro to micro levels, from structural to cognitive dimensions, from bonding to linking aspects, and from inputs to outputs (Grootaert & van Bastelaer, 2001). Currently, there are numerous general social capital measurement tools. The more notable ones include the World Bank's Social Capital Assessment Tool (SOCAT) (Grootaert & van Bastelaer, 2002) and the Social Capital [Community] Benchmark Survey in the U.S. (Harvard University, 2000). Many measures from these tools have been integrated into national census and population surveys. Grootaert and van Bastelaer (2001) advocate three types of proxy indicators to measure social capital: membership in local associations and networks, trust and adherence to community norms, and collective action. The structural indicator of group membership not only captures the number of associations and members, but also the extent of membership diversity, decision-making processes, and cultural relevancy of groups. The cognitive indicator of trust and norms adherence evaluates people's expectations of social support and behaviours by

group members that incorporates certain levels of trust. Collective action, an output indicator, reflects the social cohesiveness underlying the provision of community services or benefits (Grootaert & van Bastelaer, 2001).

Disaster resilience assessments have shown an increasing recognition of social capital's role in contributing to community disaster resilience. In a review of 14 assessments, Cutter (2016) found several recurring social capital measures across them, including participation in and saturation of civic organisations, and religious affiliation levels and the presence of religious organisations. These structural measures and measurement variables are listed in Table 7.2.

Table 7.2 *Recurring social capital measures in disaster resilience assessments*

Social capital measure	Variable
Civic organisations	• Number of civic organisations/10,000 • Civic organisations (Kiwanis, Rotary) and political organisations • Registered non-profit organisations
Religious affiliations	• Number of religious adherents (or #/10,000) • Number of religious organisations (or #/1000) • Faith-based networks

Note. From "The landscape of disaster resilience indicators in the USA", by S. L. Cutter, 2016, *Natural Hazards, 80*(2), p. 752.

While Cutter's (2016) measures focus on structural variables, the authors of this paper delved deeply into the literature to elicit other ways social capital could be measured. From 12 selected disaster resilience assessments, they identified eight social capital measurement domains (Table 7.3).

Table 7.3 *Social capital domains and measures in selected disaster resilience assessments*

Social capital domain	What is being measured?	Assessment
Group memberships and community participation	Linkages to kin and religious organisations; memberships in political, sports, faith-based, and social organisations; participation in arts and community events; volunteering rates; strengthening of interagency relationships.	1, 2, 4, 6, 7, 8, 9, 11, 12
Civic participation and governance processes	Confidence in government decision-making; sense of fairness; satisfaction with government's communications and information; satisfaction with opportunities to influence decisions; voter turnout in elections.	1, 2, 3, 5, 8, 9, 11. 12
Trust	Trust in local government to respond to community needs; trust in community leaders; trust in media representation of issues; confidence in the rule of law.	3, 9
Shared norms and values	Collective identities; similarities in cultures and language; presence of school-aged children in promoting social networks.	2, 8, 10
Culture	Proximity to cultural institutions, cultural identities, organisations that support cultural beliefs.	2, 4, 8, 11
Empowerment	Beliefs in local election voting in influencing and resolving community conditions and problems; beliefs in community groups' solving local problems; beliefs in self in influencing community conditions; beliefs in positive outcomes from community participation; personal investment in community conditions; beliefs	3, 9, 10

	in elected representatives considering residents' viewpoints and making community changes.	
Sense of community	Feeling a sense of community belonging; sharing values and community goals; sense of neighbours knowing neighbours; having a sense of community attachment; knowing community resources and leaders in resolving local issues; sense of community pride; sense of attachment to community; rate of public nuisance (e.g., graffiti and noise complaints); commitment to length of residence in community; population stability.	1, 3, 5, 8, 9
Social support and reciprocity	Number of times and types of help received; number of times and types of help given; ability to rely on neighbours for help; valuing community-based friendships and associations; beliefs in altruistic nature of neighbours.	2, 3, 4, 5, 9, 10

Assessments:

1. Canterbury Wellbeing Index (Canterbury Earthquake Recovery Authority, 2014; Morgan et al., 2015)
2. CART (Pfefferbaum et al., 2011)
3. CCRAM (Cohen et al., 2013)
4. Coastal Resilience Index (Sempier et al., 2010)
5. Community Resilience Manual – Canadian Centre for Community Renewal (Colussi, 2000)
6. Community Resilience Strategy – American Red Cross (Herbst & Yannacci, 2013)
7. NIST (National Institute of Standards and Technology, 2015)
8. Resilience Index New Zealand (Pearson, Pearce, & Kingham, 2013)
9. Resilience assessment of Auckland, New Zealand (Paton, 2007a)
10. Rockefeller 100 Resilient Cities (The Rockefeller Foundation & ARUP, 2014)
11. Rural Resilience Index (Cox & Hamlen, 2014)
12. Vulnerability and Capacity Assessment (IFRC, 2007)

Overall, social capital is measured as input indicators (e.g., civic participation), direct social capital measures (e.g., trust, shared norms), and outputs (e.g., social support, empowerment) that span both structural and cognitive dimensions. For example, while participation in community groups fosters trust between members and cultivates leadership skills, which in turn increases social support and empowers members to make decisions that benefit their communities (Becker et al., 2011; Paton et al., 2014a), assessments are more likely to quantitatively measure group memberships, civic participation, governance processes, and social support/reciprocity rather than cognitive dimensions such as trust, shared cultures and values, and empowerment.

While most disaster research on social capital adopts the three structural types of social capital – bonding, bridging, and linking (Aldrich, 2012a; Britt et al., 2012; Hawkins & Maurer, 2009; Nakagawa & Shaw, 2004), this study expands the framework of social capital to also include cognitive dimensions. The cognitive aspect is essential for understanding and evaluating how existing norms, values, and beliefs give rise to social capital and how social capital resources could be mobilised under potential natural hazard events. The study's authors adapted the conceptualisations of social capital by Grootaert and van Bastelaer (2001) and Woolcock and Narayan (2000) and developed an integrated framework (Figure 7.2) both to understand how neighbourhood stakeholders

conceptualise social capital within the context of disaster resilience and to develop micro, neighbourhood-based resilience measures.

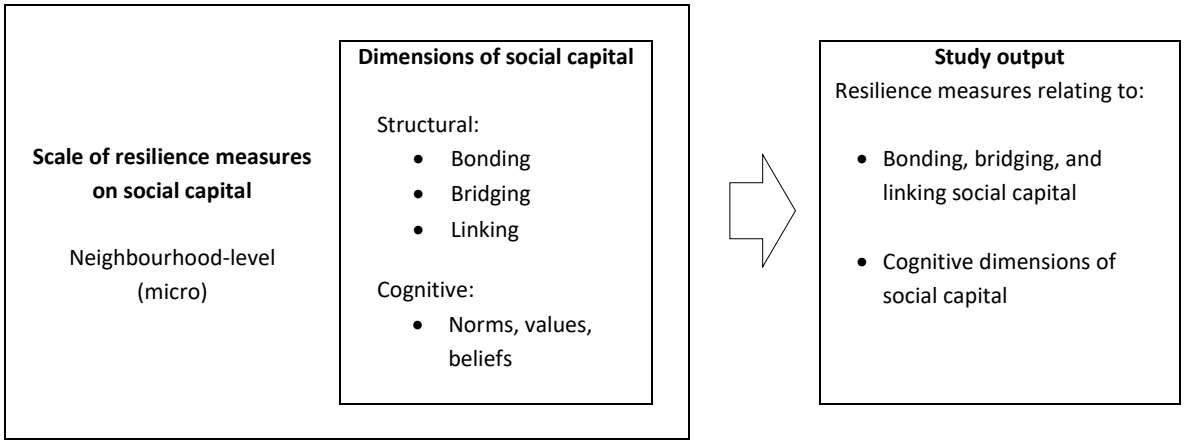

Figure 7.13 Integrated framework of social capital. Adapted from C. Grootaert and T. van Bastelaer (2001) and S. Szreter and M. Woolcock (2004).

7.2 Methodology

7.2.1 Study areas

To solicit a range of stakeholder perspectives, the authors selected five neighbourhoods with wide-ranging socioeconomic levels and racial/ethnic compositions as research sites – two in the Wellington region of New Zealand and three within the City and County of San Francisco, U.S. These two urban regions are comparable because they face similar exposure to significant seismic hazards (Cousins, 2013b; Stirling et al., 2012; U.S. Geological Survey, 2015b) and their disaster resilience policies share an emphasis on building neighbourhood-based social capital. One of the main goals of Wellington's resilience strategy is to ensure "people are connected, empowered and feel part of a community" through participatory, place-based community planning (Wellington City Council, 2017, p. 41). In San Francisco, the city's Resilient San Francisco strategy calls for "empower[ing] neighbourhoods through improved connections" by building connected neighbourhoods and improving neighbourhoods' connections to the city government (City and County of San Francisco, 2016a, p. 104). Thus, the selection of the neighbourhoods in these two regions align with the applied nature of this research.

The selection of neighbourhoods was based on several criteria. In order to identify measures that would be applicable to different types of neighbourhoods, study neighbourhoods represented different socioeconomic levels and demographic compositions. The study's authors used government census data to identify potential neighbourhoods in each region and then consulted with emergency management practitioners and community leaders from each region to narrow the

list of study sites. This process provided opportunities for aligning the goals of the research study with those of community stakeholders. The consultation process sought to gain buy-in and engagement from neighbourhood stakeholders in the research process, with the intention of increasing the likelihood that they would adopt the resulting assessment measures.

The consultative process resulted in the selection of two neighbourhoods in the Wellington region – Brooklyn in Wellington city and Cannons Creek (consisting of Cannons Creek East, South and North) in Porirua city, and three neighbourhoods in San Francisco – Miraloma Park, Bayview, and Chinatown. A summary of the neighbourhood socioeconomic and demographic characteristics is presented in Table 7.4.

Table 7.4 *Socioeconomic and demographics of Brooklyn, Cannons Creek, Miraloma Park, Bayview, and Chinatown, as compared to averages of Wellington Region and the City and County of San Francisco*

New Zealand	Pop.	Median HH Income (NZD)	Race and Ethnicity (top three)		
Brooklyn	6,504	$102,200	European (78.7%)	Asian (11.3%)	Māori (6.5%)
Cannons Creek					
East	3,594	$47,100	Pasifika (65.5%)	European (17.9%)	Māori (17.6%)
South	1,533	$47,200	Pasifika (60.3%)	European (23.9%)	Māori (23.9%)
North	3,132	$38,900	Pasifika (54.0%)	European (23.7%)	Māori (23.3%)
Wellington Region	471,315	$74,300	European (73.2%)	Māori (12.4%)	Asian (10.0%)
USA					
Miraloma Park	4,849	$121,151	White (57.6%)	Asian (25.2%)	Latino (9.8%)
Bayview	35,201	$49,594	Asian (32.9%)	Black (32.8%)	Latino (21.7%)
Chinatown	9,998	$18,368	Asian (80.9%)	White (12.36%)	Latino (3.7%)
City and County of San Francisco	829,092	$78,378	White (41.4%)	Asian (33.3%)	Latino (15.3%)

Note. From atlas.id (2013); San Francisco Planning Department (2012); U.S. Census Bureau (2014)

7.3.2 Participants – Sampling and recruitment

All study protocols were submitted to Massey University's ethics review board (# 4000015451). The study used purposive sampling methods to identify a mix of participants, including referrals from representatives of government and community-based agencies, recruitment by neighbourhood leaders, flyers posted on community-based announcement boards and social media pages (i.e., community-based Facebook pages), and recruitment in areas with high foot traffic. The primary author of this paper recruited a total of 58 participants who attended one of nine focus groups between March 2016 and October 2016. Each participant was offered a retail gift card as a token of appreciation. A summary of participants' characteristics is shown in Table 7.5.

Table 7.5 *Participants' gender, and race/ethnicity*

Neighbourhood	Number of focus groups	Total number of participants	Gender		Race/Ethnicity	
			Women	Men	New Zealand (aggregated)	US (aggregated)
Brooklyn (NZ)	2	15	6	9	European: 19	African-American: 7
Cannons Creek (NZ)	2	12	10	2	Māori: 5	Asian: 9
Miraloma Park (US)	1	8	5	3	Pasifika: 1	White: 13
Bayview (US)	3	14	9	5	Did not disclose: 2	Did not disclose: 1
Chinatown (US)	1	9	5	4		
Total	9	58	35	23		

7.3.3 Focus group procedures and data analysis

As part of a larger study on social resilience, focus group participants responded to a set of semi-structured, open-ended questions. The development of the questions was informed by a workshop on social resilience conducted with disaster researchers and emergency management professionals (Kwok et al., 2016). The focus group questions pertain to four categories of social resilience: 1) skills, abilities, and knowledge; 2) community resources, which include physical assets, goods, or services; 3) values and beliefs; and 4) community processes, and are as follows: *How would you describe your neighbourhood? When you hear the phrase 'community resilience', what do you think of? What does your neighbourhood need (e.g., skills, abilities, knowledge, resources, values and beliefs, and community processes) in order to anticipate, cope with, and overcome the challenges and changes from a disaster, such as an earthquake?* Participants' perceptions on social capital were extrapolated from their responses to these questions.

It is important to highlight that while these questions do not specifically ask participants about social capital, this approach allows for an open inquiry to capture responses without constraints and limitations (Budd, 2008). As such, specific components, characteristics, and perceptions of social capital and potential interdependencies of social capital to other factors relating to disaster resilience can be examined.

Each focus group was conducted in English and lasted one and a half hours. All focus group discussions were audio-taped and transcribed verbatim, with the exclusion of 'ums' an 'ahs' during the transcription process. The transcriptions were coded and analysed inductively by identifying recurring patterns (themes) in the data that related to the existing framing of social capital from the literature (Braun & Clarke, 2006) as discussed in Section 7.2.

7.4 Results

The analysis of focus group data produced three overarching themes that underpin the perceived formation, activation, and benefits of different dimensions of social capital (i.e., structural or cognitive; bonding, bridging, or linking) within the context of neighbourhood resilience. Using selected participant quotes, this paper illustrates each of the three themes: community demography, cultural influences on social support, and neighbourhood governance. The paper also discusses the implication of each theme on measuring social capital.

7.4.1 Community demography: Length of neighbourhood tenure and demographic changes

The community demography theme consists of two dimensions as they pertain to bonding social relationships and community identities: length of residence (tenure) and demographic changes. First, a high rate of homeownership contributes to neighbourhood resilience by strengthening social connections and community attachment. This was especially true in the study for the high socioeconomic neighbourhoods of Brooklyn and Miraloma Park, as well as the low socioeconomic neighbourhood of Bayview, which has one of the highest homeownership rates in San Francisco (Roscoe, 1995). A participant in Brooklyn said:

> *I think there's a sense that you are gonna be here longer. I flatted here when I was in university, and* [I had] *nothing to do with the community. My community was downtown – socialising at the university and I slept here when I got back here, that was it. I think also homeowners are, they don't all, they're more likely to have children … When people got children they become a lot more cemented because they are using the facilities.*

This excerpt also underlies the importance of tenure stability in promoting disaster resilience. When asked about what would happen to Bayview after a disaster, without skipping a beat, a participant declared, 'Bayview will rise'. The participant pointed to the history of events that have tested the strength of the community – from racism to violent crimes to fires – and believed the deep bonding social ties that have been built over the years in overcoming these challenges would sustain the community in a major disaster:

> *Time and time and time, over and over, th[is] community has risen up without a community plan. They know who lives where. Because people have lived there for 30, 40, 50, 60, 70 years. If, when we had an earthquake, we didn't need no one to come in and tell us. You would've checked on your wife, on your elder, on your senior, or the person you know who is in a wheelchair. The community has rose to the occasion [to a building fire]. They rallied around with them [the displaced residents] less than eight hours later … They didn't have to be coached, prodded, or urged, or looking for recognition. They just automatically, with*

> *instinct of community and family, rise to the occasion. So I don't believe that we won't continue to rise.*

However, for neighbourhoods with a more transient population (i.e., renters) such as Cannons Creek, enhancing community resilience requires providing disaster preparedness education to this segment of the population. According to a Cannons Creek's participant:

> *The other thing about our community, it may be not as much as it was, but it's quite a transient one, because there's lots of renters. People come and go a lot. So we can't assume everyone knows* [about where to go and what to do in a disaster]*, because they might've just arrived.*

Second, community demographic changes affect pre-existing social networks and functions. This could be viewed as a resilience impediment or an enhancer, depending on how such changes are perceived to impact community identities and cultures. For participants, positive perceptions were associated with demographic changes that built upon the existing strengths of a neighbourhood, while negative perceptions were characterised by changes that replaced long-established community identities and cultures through residential displacement. An example of the former was illustrated in the more socioeconomically homogenous neighbourhood of Miraloma Park, where an influx of new residents was viewed to positively contribute to the community, as a participant said:

> *When we moved in here 17 years ago, my daughter was the only kid in the entire block. I think it's actually completely flipped now to see many, many young families and young kids … I haven't seen those families move out, which is really nice to see.*

However, newcomers to a neighbourhood can threaten the strength of bonding social capital when they displace long-term residents, especially those who are low-income and are racial minorities. In Bayview's focus groups, African-American participants conveyed a sense of community loss as they felt their historically African-American neighbourhood (Higgins, 2004) was gradually eroding due to the high cost of living and doing business. As one participant explained:

> *When I came out in '73 … they had Black stores and all kinds of businesses and stuff. And over the years, that disappeared. But then it's* [presence of businesses] *on the rise again. But … the fact you don't see many Black business. You don't see many black people; you don't see people that occupying the housing, the homes*.

While negative perceptions toward demographic changes were especially apparent in Bayview focus groups, other discussions also pointed to the evolution of social networks over time. Despite rapid demographic changes and a projected decline in racial diversity in San Francisco communities (PolicyLink & PERE, 2015), a Bayview focus group participant believed that new residents would eventually be considered part of the community and that the initial perceived divide ('us vs. them')

would ultimately dissipate as they became part of the neighbourhood. This particular view illustrates that social relationships within a neighbourhood can evolve from bridging to bonding relationships.

Even though differences between focus groups existed across all the studied neighbourhoods, common to all of them was the perceived need to preserve community cultures and identities amid demographic changes or after a disaster. This point was conveyed by a Bayview focus group participant:

> *And over 10 years from now, call it two years from now, how much of the same population will still be populating right here – that's the longer measure* [of] *community resilience – are you scattered to the four winds? Even though new people live here … so there's that geographic versus cultural.*

The perceived and actual changes in community demographics, therefore, influence the quality and strength of social connections, which in turn affect perceived characteristics of resilience such as community identity, collective action, knowledge of community resources, community attachment and social support. For communities with vulnerable populations, maintaining residential stability is essential to the development of city policies. These policies, as stated by focus group participants, should include expanding affordable housing for low-income residents, improving public transportation and community amenities, ensuring local ownership of businesses, and implementing local hiring policies in a post-disaster environment. San Francisco has recently approved policies and programmes to ensure the retention of low-income residents in the city (refer to Goal 3 of the city's resilience strategy, City and County of San Francisco, 2016a) and the hiring of local residents in city-funded construction projects (San Francisco Office of Economic and Workforce Development, 2010). These city-level structural interventions are critical to maintaining individual, household, and neighbourhood levels of social resources and resilience.

The implication of community demographic changes on social capital measurements is discussed next.

7.4.1.1 Measuring underlying drivers and impacts of demographic changes

Participants perceived that communities facing rapid demographic changes and gentrification might face new vulnerabilities if long-term residents were to leave, eroding or severing important relationships that had formed over years. This is especially likely for residents from disadvantaged communities, where place-based bonding and bridging relationships have been documented to provide residents with the necessary resources to meet the challenges of everyday life as well as in disaster situations; the strength and power of these relationships evaporate when people move out (Elliott et al., 2010; Litt, 2008). In a comparative study of social capital between low- and high-

income communities in the aftermath of Hurricane Katrina, Elliott et al. (2010) found that displaced low-income residents had difficulties accessing benefits from their local social networks. Consequently, they received less informal social support, took longer to return to their neighbourhoods, and experienced more significant challenges in re-establishing their local social networks than their wealthier counterparts. The financial security of the latter afforded them better access to their informal networks through means such as private transportation, and, in turn, increased the flow of information on rebuilding resources and incentivised the return of neighbours (Elliott et al., 2010). These results highlight the need for preserving place-based social networks that are vital to the material and social well-being of residents, such as ensuring that neighbours are relocated proximally in a disaster.

Residential stability, as it relates to homeownership and length of residence in a neighbourhood, is found to be positively correlated with place attachment through increased social ties (Brown, Perkins, & Brown, 2003). Place attachment, which is the positive cognitive and affective bond that people have to their environment (Altman & Low, 1992), has been documented to promote civic participation and neighbourhood revitalisation efforts (Brown et al., 2003; Conway & Hachen, 2005; Manzo & Perkins, 2006). However, people who do not stay in one place for long reduce their chances to develop the emotional connection to their neighbourhood that is foundational to community engagement (Manzo & Perkins, 2006). Increasingly, disaster researchers have identified the importance of the linkages between residential stability, social capital, and place attachment in influencing disaster outcomes. For instance, Bihari and Ryan (2012) conclude that residents with higher perceived social capital and place attachment levels are more likely to take hazard mitigation actions and engage in community hazard planning. Another study by Chamlee-Wright and Storr (2009b) found that despite structural constraints such as racism, poverty, and government incompetence that had prevented many residents from returning to their homes after Hurricane Katrina, those who did return cited their attachment to their neighbourhoods as a primary reason.

Because residential stability is essential for maintaining the necessary social connections that facilitate disaster response and recovery efforts (Sherrieb et al., 2010), measuring social capital needs to not only capture the rate of homeownership and length of residence quantitatively, but also assess those factors' impact on the well-being of vulnerable residents, community identity, and community engagement.

The next section examines the role of neighbourhood-level social connections in providing residents with a sense of social support in everyday situations and during times of stress.

7.4.2 Cultural influences on social support

The second theme, cultural influences on social support, can be traced to participants' cultural values, beliefs, and norms. While culture can be conceptualised in different ways, this paper adopts Triandis's (2002) formulation of culture as comprised of elements that are both physical (e.g., buildings, tools) and subjective (e.g., social norms, roles, beliefs, and values). This study focuses on the subjective dimension of culture. The authors identified two recurring subjective cultural components that affect social support (an output of bonding social capital): unspoken duties as neighbours and participants' cultural values and norms.

Regardless of socioeconomic and demographic differences between neighbourhoods, all focus group conversations emphasised the normative value of neighbourliness, or a sense of duty as neighbours. The importance of bonding relationships is conveyed by participants' beliefs in 'neighbours helping neighbours' across a range of situations, from dealing with everyday stresses to preparing for and responding to disasters. Participants felt that social relationships are foundational to social support in everyday situations. For instance, a participant expressed the deep social ties that exist in her community when recounting the death of an immigrant local business owner:

> *The H&K* [liquor and deli store] *on the corner of Jennings* [Street] *and Fitzgerald* [Avenue]*, the mother, people called her 'grandma', passed away.* [Residents] *mourned* [her] *loss … as if though she was our grandmother. I could remember when my grandmother sent me to the store and go there to buy Pall Mall Red cigarettes for my grandmother, because the store knew us. So they became part of the community … The oldest brother at H&K, at the funeral, he said, 'I want to thank you community, because of the death of our mother, you guys held us up.'*

In preparing for and responding to disasters, participants recounted past experiences of either taking upon their neighbour's preparedness efforts themselves or assisting their neighbours to prepare for a disaster, such as knocking on each other's doors when there was a flood (Cannons Creek focus group). Participants indicated that neighbours play a vital role in providing support for vulnerable residents (e.g., the elderly), providing information such as hazard risks and community resources to the neighbourhood, and organising others to help advocate for community needs. The unspoken duty as a neighbour is captured in the following quote:

> *I know who my next door neighbours are. They might not know who I am, but I do know who they are. I know they've got two dogs. I know that down the road has about three or four cats. What I try to do, or what I am working trying to do, is just to build up a stock of cat and dog food. Canned goods for myself and possibly canned goods for others* (Brooklyn focus group).

The other cultural component of social support is a shared sense of cultural connections and beliefs rooted in participants' race or ethnicity. This was particularly evident by participant comments in Chinatown, Bayview, and Cannons Creek, which have high numbers of racial or ethnic minorities, and was less present in the racially or ethnically homogenous neighbourhoods of Brooklyn and Miraloma Park. Discussions in the Chinatown, Bayview, and Cannons Creek focus groups highlighted the importance of embedded cultural values within the Chinese, African-American, and Māori (New Zealand's indigenous people) communities in supporting those in need. Chinatown focus group participants also conveyed a shared sense of cultural identity. For example, when participants were asked whether they would return to Chinatown after a disaster, a participant said, '*I will come back to help … because we are all Chinese people'*. According to focus group participants, this sense of shared identity was reinforced not only because of the homogenous demographics of the community, but also because many residents residing in the community were immigrants themselves. The perceptions of participants suggest that residents believed they had to support each other in their newly adopted country.

In the Bayview focus groups, participants discussed at length the importance of bonding social capital embedded within extended families – whether they were blood-related or not – within the African-American culture in helping to raise families and support each other. A participant illustrated this sense of communal duty to build families through an everyday scenario:

> *I would throw a rock at Mr. B, or get sassy with him at the ice-cream parlour. Before I got down to Gilman Street, Ms. Sarah said, 'You were over there in the afternoon. I've seen you throwing some rocks.' When I get to* [my] *grandmother's house, she's already outside. I didn't have to wait to tell her. The community reprimanded me.*

Furthermore, neighbourhood-based cultural institutions facilitate the activation of bonding social capital and provide critical social support for residents in natural hazard events. In Cannons Creek, a recent flood prompted a local marae (Māori community centre) to open a soup kitchen that served residents in need. These institutions act as moderating influences on a neighbourhood's social capital.

Responses from participants relating to the theme of cultural influences on social support point to the importance of cultural norms and values in cultivating social support among neighbours. The next section discusses the implication of cultural values and practices in the development of social capital measurements.

7.4.2.1 Measuring the integration of cultural values and practices in disaster risk reduction (DRR) interventions

Cultural factors play a vital role in the ways people and groups prepare for and recover from disasters (Norris & Alegría, 2008). They also shape the ways in which people and communities connect with each other, which in turn affects how people receive and personalise hazard risk information, take protective actions, and respond to and recover from disaster impacts (Paton, Okada, et al., 2013). Given the importance of the cultural context of social networks, more needs to be done by community resilience assessment tools to account for place-based and context-specific cultural values, beliefs and practices – the cognitive components of social capital. One way to measure the cultural dimension of social capital is by assessing the extent of integration of cultural values, beliefs, and practices in the planning and implementation of strengths-based DRR interventions. Such interventions build on pre-existing social and cultural community assets to produce outcomes that encapsulate the socio-cultural fabric and diversity of a community. Participants who were racial or ethnic minorities in this study conveyed their cultural values when articulating their need for culturally-appropriate interventions that support the psychological resilience of residents. In Bayview, several focus group participants referred to a lack of culturally competent psycho-social services provided to racial minorities. As a participant in the Bayview focus group stated:

> *With Black folks, you can't always say, 'You are suffering from PTSD, come over here and let me work with your mental health' – you've just shut them out. You gotta meet them at where they are. So if they are having mid-night basketball, this is just an example … Well, all those 200 people sitting in the stands that are waiting for the game to start, you* [service providers] *should come there and just do healing, not talk about why aren't you going to mental health. Historically, African-Americans didn't buy into mental health, counselling, all those things. When you did it, you snuck it in. We didn't believe in a lot of that psychological and go see a psychiatrist, and all those therapists.*

This quote highlights the need for aligning cultural values and practices of individuals and communities with DRR interventions. A successful integration can be found in Chinatown, San Francisco. The Chinatown Disaster Preparedness Committee, led by the NICOS Chinese Health Coalition, was formed after the 1989 Loma Prieta earthquake to address the training, preparedness, and response needs of the predominately Chinese community (Center for Infectious Disease Research and Policy, n.d.). The committee created a bilingual disaster response plan that addressed the response actions of the community during the first 72 hours after a major disaster (NICOS Chinese Health Coalition, 2007). Participants in the Chinatown focus group felt that having both a dedicated committee and a neighbourhood-specific disaster response plan that meets the cultural

and linguistic needs of community stakeholders is essential for the recovery of their community after a disaster.

Beyond the neighbourhood level, the integration of cultural knowledge and assets of groups in policies and practices at all levels of government is essential to enhancing the adaptive capacities of neighbourhoods (IFRC, 2014). An example of national-level DRR policies that integrate cultural practices can be found in New Zealand. The National Civil Defence Emergency Management Plan outlines the role of Te Puni Kōkiri – a national government agency in responsible for leading Māori public policy and advising policy affecting Māori wellbeing – in linking iwi (Māori tribes) and Māori groups with government agencies and authorities during and after an emergency event (Ministry of Civil Defence and Emergency Management, 2015; Te Puni Kōkiri, n.d.). Additionally, government-funded research initiatives for building New Zealand's disaster resilience specifically call for the integration of Māori cultural beliefs and practices within its national resilience strategy (Ministry of Business Innovation and Employment, 2016). However, much more work needs to be done in incorporating cultural sensitivity in disaster planning (Elder et al., 2007). A way forward is to create a DRR engagement and planning framework in collaboration with cultural and ethnic groups. Assessment tools can contribute to such an effort by setting goals and key performance indicators in this regard.

The next section illustrates how the strength of social capital in each of these neighbourhoods is also influenced by the effectiveness of neighbourhood governance.

7.4.3 Neighbourhood governance – Collective action, advocacy, and leadership

Governance at the neighbourhood-level is often informal by nature (Lelieveldt, 2008). As such, the final theme centres on a neighbourhood's bridging and linking social capital resources and capacities as they relate to its experiences in collective action, ability to advocate for community-wide needs, and presence of effective neighbourhood leaders in contributing to effective neighbourhood governance. These three components of neighbourhood governance draw attention to the perceived importance of residents and community-based organisations (CBOs) coming together (bridging social capital) to resolve community-wide challenges and advocate for their needs (linking social capital).

Focus group data suggest that all neighbourhoods possess and have activated a certain degree of bridging social capital resources and capacities. In higher socioeconomic neighbourhoods, a Brooklyn focus group participant recounted how residents gathered to help fundraise to rebuild a community hall which was razed by a fire, and Miraloma Park participants discussed how neighbours and groups

came together to create (and have continued to sustain) a community-wide neighbourhood association that would be able to handle future disasters. Although low-income communities might be labelled as vulnerable to a variety of external threats and hazard events, the perspectives of participants from low-income neighbourhoods (Cannons Creek, Bayview, Chinatown) illustrate that the vulnerabilities of their communities can be ameliorated by strong pre-existing social and organisational connections. In Cannons Creek, participants discussed a time when residents and community-based organisations came together in council meetings to advocate for the wellbeing of residents by protesting the approval of a liquor license for a local business. They felt such actions demonstrated the strong neighbourhood ties that could be deployed in future natural hazard events. In Bayview, a participant pointed out Bayview's ability to prevail from a hazard event because of its network of individuals and community-based organisations:

> [From the] *extended families to the service providers and organisations here, who* [for] *generation and generation, their kids can go back and be like, 'So and so still work in here. So and so helped my kids. You can go to so and so, they can be trusted cause it's consistent, right? And this person is like my auntie …' I think that speaks volumes – you need that especially those who you are working with … You need to have that base ... You have a lot of people here in Bayview who fit that role – and that's really rare. I agree that has made this community very, very resilient.*

In another example, local activists and CBOs of San Francisco's Chinatown have long fought for the preservation of the Chinese culture and the neighbourhood's way of life (Green, 2016). There was a wide-spread belief among focus group participants in Chinatown that the network of Chinatown-based CBOs would continue to ensure that the community culture and rights of residents would be protected. This belief was expressed within the context of disaster recovery:

> [Chinatown organisations] *advocate for a lot of things, like equality, opportunity, [stopping] mistreatment in the workforce or workplaces; they assist individuals with that. I feel like that organisations will be the first to say, 'Okay, we've gotta maintain the culture of Chinatown.'*

Regardless of a neighbourhood's socioeconomic level, participants generally expressed a need for effective community advocacy, which rests on having a leadership that unites and represents the interests of different community groups in local governments (linking social capital). They believed unified leadership is crucial to building resilience in both the pre- and post-disaster environment. However, focus group data highlight differences in the existing levels of linking social capital resources and capacity between high and low socioeconomic neighbourhoods, in which leadership within higher income neighbourhoods appeared to be more unified than their lower income counterparts.

An example of a unified leadership in a community setting is exemplified by CBOs such as the Miraloma Park Improvement Club (MPIC), which represents the interests of residents (Miraloma Park Improvement Club, 2016). A participant in the Miraloma Park focus group believed the MPIC is expected to play a vital role in community recovery:

> *We have a place – MPIC – is going to become really important, and part of the reason is you need some governance. I think it's really important that in order for a neighbourhood to have a voice and be heard by either an elected official or by a utility company or by a fire station or by a road paving* [agency]*, in order to get road paving or road repair type of thing, we need to have some sort of a group that speaks for more than just one person. And I think we are fortunate that we have MPIC. And MPIC has spoken loudly in the past and we've gotten things and I think we are known in City Hall. So all of that helps in a sense that we have this in place already in times of no stress. So during times of stress, hopefully this group will be able to work together to build what we need in terms of leadership. Let's put it that way, that's a way of building leadership in order to recover and get the neighbourhood up on its feet.*

In Brooklyn, similarly, the community disaster response planning sessions conducted by the local emergency management agency have brought together key community leaders, many of whom participated in this study. Focus group participants believed that if something were to happen in their neighbourhood, they would know how to work together to get needed resources. However, participants' responses in low income neighbourhoods such as Bayview and Cannons Creek alluded to an absence of bridging social capital in the form of unified leadership representing different community priorities. This could be partly attributed to the fragmented approaches used by local government agencies in allocating resources and services. As explained by a participant in Cannons Creek:

> [After a disaster,] *we have to look after ourselves. So we are resilient. We are ready but … The churches will be the hubs, the schools, the marae* [Māori community centre]*, and they will be the centre point. But they don't want us to be huddled apparently. They* [Civil Defence] *still want us to keep separate* [in silos]*.*

A similar sentiment was also expressed by a Bayview participant:

> *Bayview is very diverse, but it's still very segregated in many ways. And I think some of the challenges as we've mentioned are common throughout because at the end of the day, the majority of folks who live here are of low income, as least relative to San Francisco. So I think that there isn't a bonding of bringing all those entities together to unite and actually have a larger voice to advocate for at least the common challenges that this community and what does this community needs … I think* [governmental] *leadership plays to that. They play to the fragmentation*.

Focus group participants from Cannons Creek and Bayview also felt the need to increase the linking type of social capital by ensuring that local governments would be more transparent and accountable to their constituents through increasing community participation and inclusion in the decision-making process. In the fast-changing neighbourhood of Bayview, the need for community inclusion is more salient. For instance, participants felt that social housing decisions that they believed to have caused the displacement of many low-income residents and African-Americans were made '*behind closed doors*' or '*under the table*'. When participants were asked who was making those decisions, they responded, '*The people who have the power to do it*' or '*the people with money*'.

Participants from Bayview and Cannons Creek believed that many of these challenges were the result of long-standing discriminatory structural policies of the past that have shaped socioeconomic disparities between the rich and the poor and between those in power and those who have traditionally lacked power and been disenfranchised (e.g., minorities, women, low-income individuals, and the elderly). They believed that increasing access to information and providing opportunities for engagement are essential to empowering underserved residents in the DRR planning process. Across all neighbourhoods, participants conveyed their need to be empowered to make the best choices for themselves and their community in a disaster environment. Underlying these sentiments are cognitive issues of trust toward CBOs, decision-makers, and decision-making processes.

7.4.3.1 Measuring neighbourhood governance by assessing the effectiveness of civic infrastructure

The previous section highlights that bridging and linking social capital resources can be enhanced and effectively activated through coordinated leadership and collective efforts. Measuring neighbourhood-based governance can be achieved through assessing residents' perspectives on the effectiveness of local leaders (Paton, 2007a), and the evaluation of civic infrastructure – the networks of community-based organisations and groups – can serve as proxies for leadership capabilities (Graham et al., 2016). In particular, focus group data illustrate that collective efforts are frequently facilitated by formal and informal community groups. Results from focus groups are consistent with past research studies that demonstrate the importance of civic infrastructure in capitalising existing community strengths and capabilities to building disaster resilience (Graham et al., 2016). For instance, neighbourhood-based groups provide avenues for cultivating beliefs, skills and capacities (e.g., trust, leadership, community engagement, and social networks) that enable local stakeholders to effectively resolve conflicts and prioritise their needs (Becker et al., 2012).

These groups also affect individual and community disaster preparedness (Becker et al., 2012) and recovery of communities (Chamlee-Wright & Storr, 2011; Montgomery, 2013; Nakagawa & Shaw, 2004; Simo & Bies, 2007).

Effective civic infrastructure in a disaster environment requires the presence of proactive leaders. For instance, Paton et al. (2014) find that community groups with passive leaders – people who waited to be told by government entities what they should do – invariably closed off opportunities for community engagement and prolonged a sense of community uncertainty that undermined its recovery. Even in high socioeconomic communities, disaster recovery can be hampered due to ineffective leaders or emergent leaders who lack the capacity for organising in-situ (Paton, Mamula-Seadon, et al., 2013). Their study also finds that organisations and groups that did evolve into effective recovery entities demonstrated several common attributes, such as having active leaders and an inclusive community planning process (Paton et al., 2014).

Since informal and formal networks and leadership contribute to neighbourhood-level social resources, resilience assessment tools need to reflect not only the presence of active community leaders and density of community-based organisations and groups, but also their effectiveness in bringing about changes, whether in securing resources or advocating for the collective needs of a neighbourhood from decision-makers. Additionally, assessment measures need to account for the extent of collaboration between organisations, their ability to meet the needs and enhance the capacities of their constituents, and issues relating to trust in leadership and decision-making bodies and processes. Hence, the ability to baseline and track progress of civic infrastructure's capabilities and processes (i.e., leadership, decision-making process, and trust towards the governing process), especially in culturally and ethnically diverse and low-income communities, is essential as they positively influence the trajectory of post-disaster recovery (Storr & Haeffele-Balch, 2012).

7.5 Proposed measurements for neighbourhood-based social capital

The three themes of community demography, cultural influences on social support, and neighbourhood governance unveil opportunities for integrating community perspectives in social capital-related resilience measurements and DRR interventions at the neighbourhood level. Although the importance of social networks and capacities is increasingly being recognised by disaster management policymakers and practitioners, assessing social capital and its nuances has yet to be fully integrated into community-based disaster planning process, in both rural (LaLone, 2012) and urban settings (Montgomery, 2013; Schmeltz et al., 2013). While the three themes identified in this study are often shaped by policies and structural mechanisms that are implemented at the city

level, specific neighbourhood-level measures and DRR actions could be developed that reflect local beliefs and needs.

This study proposes in Table 7.6 an initial set of measures that can be used to assess social capital levels across the study neighbourhoods. These measurements, which are based on the integrated framework presented in Figure 7.2, can be used to support neighbourhoods' efforts in evaluating and setting targets toward enhancing the multiple dimensions of social capital. The measures are presented in a matrix table that categorises social capital into structural and cognitive dimensions across bonding, bridging, and linking relationships.

The structural dimension of social capital relates to social organisations (Uphoff, 1999) and consists of six factors essential to enhancing horizontal and vertical linkages (i.e., bonding, bridging, and linking relationships):

- Population stability
- Neighbourhood-based organisations and groups
- Coordination between community-based organisations
- Linkages to cultural and ethnic minority communities
- Presence and effectiveness of neighbourhood leaders and CBOs
- Inclusive and transparent government processes

The cognitive aspect of social capital, which relates to civic culture (Uphoff, 1999), spans across these relational linkages and comprises four factors, as follows:

- Cultural beliefs and expectations
- Trust
- Social support
- Empowerment through collective action

Two types of assessment measures are proposed for each factor. The first type of measures consists of quantitative indicators (as denoted by 'I') that either directly or indirectly (using proxy variables) assess the discrete aspects of each factor. The second type involves a set of open-ended questions (as denoted by 'Q') that seek to explore the contexts of social capital sources and manifestations in each neighbourhood. The mix of quantitative indicators and exploratory questions in this integrated approach seeks to assess neighbourhood-level social capital more holistically than has been done to date. While the indicators provide a quick and easy measure of the structural aspects of social capital, answers to the contextual questions can reveal underlying assumptions, beliefs, and practices of neighbourhood stakeholders that are valuable in developing neighbourhood-relevant DRR interventions that facilitate the development of social capital.

The proposed measures in Table 7.6 are based on the findings of focus groups from the study sites. The authors caution readers in applying these measures to other communities as they may not be applicable in different geographical contexts (e.g., perceived social support might be measured differently in different countries). Rather, the authors want to emphasise the need for an integrated approach to assessing social capital at the neighbourhood level.

Table 7.6 *Proposed common indicators and contextual questions for measuring neighbourhood-based social capital*

Social Capital Indicators (denoted by 'I') and contextual questions (denoted by 'Q')			
	Bonding	Bridging	Linking
Structural	**Neighbourhood-based organisations and groups** I Number and type of associations I Memberships – rate of participation I Volunteer rate Q What are the key community-based organisations? Q Which of those are essential to assisting vulnerable residents? **Population stability** I Length and changes in residential tenure I Ratio of renters/homeowners I Changes in demographics (e.g., ethnic and racial makeup, age, and income) over a five-year period Q What factors are driving people in/out of the neighbourhood? Q How have demographic changes impacted community cultures and social connections of residents, especially vulnerable residents? Q How effective are current policies (e.g., affordable housing legislations) in maintaining the stability of low-income and minority residents?	**Coordination between community-based organisations** I Number of agencies collaborating on government-funded services I Presence of interagency group I Frequency of neighbourhood-wide programmes/events Q What mechanisms, either through policies or government funding, could enhance collaborations between community-based organisations? Q What barriers (e.g., time, personalities, funding) exist that prevent community-based organisations and groups from collaborating? **Linkages to cultural and ethnic minority communities** I Number of groups and associations serving racial and ethnic minorities I Racial and ethnic composition of DRR groups I Extent of cultural practices integrated in neighbourhood-based DRR planning process and plans? Q How frequently do groups serving racial minorities and non-racial minorities work together?	**Effective neighbourhood leaders and CBOs** I Number of neighbourhood leaders I Amount of resources (e.g., financial, goods or services) secured for communities by leaders/CBOs Q Who are the key neighbourhood leaders and which segment(s) of the neighbourhood do they represent? Which communities are not represented by these leaders? Q What neighbourhood challenges have yet to be addressed by local government agencies or community-based organisations? Q What programmes are in place or can be developed in cultivating the capacities of neighbourhood leaders and engaged residents? Q What mechanisms are in place or can be developed to make neighbourhood leaders accountable in representing neighbourhood priorities in local governments? **Inclusive and transparent government processes** I Existence of community outreach plans within local government agencies. I Frequency of community-wide meetings?

			I Extent of integration (e.g., low, medium, high) of community needs and priorities in city-wide emergency plans? Q How engaged are community members in government's decision-making processes? What factors are preventing the engagement of community members? Q What programmes or incentives can be developed to promote community engagements? Q How are cultural values and practices being integrated in DRR planning and implementation processes?
Cognitive	**Cultural beliefs and expectations** I Number of languages spoken in neighbourhood I Percentage of racial and ethnic residents in neighbourhoods Q What different cultural beliefs and practices are prevalent within a neighbourhood? Q How can existing cultural beliefs and practices be promoted and celebrated within the wider community? Q What existing cultural conflicts, if any, exist between communities? How could such conflicts be resolved? **Trust** I Levels of trust (e.g., low, medium, high) between neighbours, toward community-based organisations, and toward government processes Q What experiences have cultivated or eroded trust between communities, toward community-based organisations, and toward government agencies? Q What needs to occur to mend relationships where trust has been eroded? Q What steps could be taken to develop stronger trust between people and organisations?		**Social support** I Frequency of giving/receiving help I Percentage of perceived social support Q What social networks provide support in times of stress? Q What experiences have strengthened or eroded such support? Q What impact do existing community programmes have on increasing perceived levels of social support? **Empowerment through collective action** I Frequency of collective experiences in dealing with neighbourhood-wide challenges and hazard events I Percentage of perceived belief that community members will come together to resolve neighbourhood-wide problems Q What are some of the key issues that bring community members together? Q What factors enhance or hinder the ability of community members to come together? Q How could barriers to collective actions be reduced?

7.5.1 Structural social capital factors

The first two structural social capital factors – population stability and neighbourhood organisations and groups – assess the strength of bonding social capital.

Population stability

Key quantitative measures of a neighbourhood's residential stability include the length of residential tenure, ratio between renters and homeownerships, and demographic changes. While these measures have been used in various community resilience tools (e.g, Cutter et al., 2014), this study's social capital assessment framework also evaluates underlying drivers of changes. Contextual questions ask neighbourhood leaders and long-term residents their understanding of influences that have contributed to demographic changes and the impacts that such changes have on social relationships between people. In particular, these questions focus on vulnerable populations (e.g., low income and racial or ethnic minority residents) as they are often disproportionately affected by disaster consequences (Norris & Alegría, 2008). Their ability to activate resources through their social networks is essential to buffering the impacts of disasters. Answers to these questions could inform existing policies that maintain social connections by preventing or slowing an exodus of established residents.

Neighbourhood-based organisations and groups

This factor measures the sources of bonding social capital as they relate to civic infrastructure. Variables that assess bonding social capital levels include the enumeration of civic infrastructure and community participation. Research suggests that existing levels of community groups and participation have a positive correlation to social capital, which in turn contributes to disaster resilience (Vallance, 2011b). Supplementing these measures are exploratory questions that identify critical community-based organisations, especially those that serve the needs of vulnerable residents. Neighbourhood leaders and government decision-makers can use information gleaned from the data to ensure that appropriate levels of resources are allocated to these organisations.

The next two factors assess bridging social capital by assessing the extent of coordination between community-based organisations and their linkages to minority communities.

Coordination between community-based organisations

Key quantitative measures for this factor assess the extent to which community organisations and groups collaborate with one another and with different communities. Collaboration and coordination between community-based organisations enable timely disaster response and recovery

(Johnston, Becker, & Paton, 2012). The study uses a measure to assess how frequently different communities come together, as neighbourhood-wide events enhance social capital and disaster resilience (Okada, Yokomatsu, & Ikeo, 2010). The exploratory questions seek to understand existing gaps and barriers in interagency coordination.

Linkages to cultural and ethnic minority communities

As discussed previously, cultural and ethnic minority communities are disproportionately impacted by disasters for reasons such as discrimination and inequalities in first response (Elder et al. 2007; Norris & Alegría, 2008). This factor seeks to assess bridging relationships between mainstream groups and organisations and those that serve racial and ethnic minorities. Measures for this factor, therefore, assess the number of community groups serving racial and ethnic minorities and the existing collaboration between them and non-racial minority groups. As it pertains to disaster resilience, an assessment question also evaluates the extent to which cultural practices of ethnic groups are integrated in disaster planning process and plans. This question highlights an existing need for culturally-appropriate disaster risk reduction plans (IFRC, 2014).

The last two structural factors assess governance capacities and efficacy of a neighbourhood's linking social capital.

Presence and effectiveness of neighbourhood leaders and CBOs

As discussed in Section 7.4.3.1., proactive local leadership and effective community-based organisations are key to timely disaster response and recovery of communities. Quantitative measures – the presence of neighbourhood leaders and their track records in securing resources – assess the likelihood of neighbourhoods receiving the necessary tangible and intangible resources for disaster risk reduction and disaster response, which is critical in a post-disaster environment (Aldrich, 2012a). Open-ended questions delve into leaders' abilities to represent the collective interest of their communities, identify underserved communities and community needs, examine existing processes that neighbourhood stakeholders can use to hold their leaders accountable, and develop capacity-building programmes for existing and emergent neighbourhood leaders. These questions address key concerns raised by focus group participants to ensure that the voices of minority groups are heard, leaders and community-based organisations are held accountable to their constituents, and mechanisms are employed to bring about positive community changes through capacity-building and access to decision-makers.

Inclusive and transparent government processes

Essential to community disaster resilience is ensuring that decision-making processes are inclusive and fair (Burby, 2003). The set of quantitative measures evaluates the engagement process by assessing the presence of community outreach plans and community-wide meetings by local government agencies. Focusing on disaster management, these questions also assess whether local needs are integrated into existing emergency plans. It might be that local governments are already outreaching to communities for input on various decisions. As such, the exploratory questions gauge the extent of community engagement in decision-making processes and barriers to engagement, as well as identifying and incorporating cultural values and practices into DRR planning. Addressing these questions enables emergency management practitioners and policymakers to enhance local participation so outcomes of the planning process reflect local priorities.

7.5.2 Cognitive social capital factors

The four cognitive social capital factors that have been identified from focus group data are integral to the formation and manifestation of social capital. Thus, stakeholders involved in assessing neighbourhood disaster resilience should consider how each cognitive factor influences the quality and effectiveness across the different types of social capital.

Cultural beliefs and expectations

Consisting of discrete measures, such as the number of languages spoken in a neighbourhood and the percentage of racial and ethnic residents (Cutter et al., 2003), along with open-ended questions that explore how cultural beliefs and practices manifest within a neighbourhood, this factor examines the intersection among race, culture, social capital, and disaster resilience. Since differences in cultural practices affect how specific communities form relationships and respond to disasters (Chamlee-Wright & Storr, 2010), cultural measures offer insights into prevention, response, and recovery actions that need to be taken in a post-disaster environment. For instance, the celebration of cultural beliefs and practices in neighbourhood-based events signal inclusiveness that needs to be replicated during disaster recovery.

Trust

Trust is an integral measure of the cognitive dimension of social capital, such as that used in World Bank's Social Capital Assessment Tool (SOCAT) (Grootaert & van Bastelaer, 2002) and in various community disaster resilience assessments (see Table 7.3). Complementing quantitative measures of trust are questions that seek to understand how trust at the neighbourhood level has been

enhanced or eroded in the past. Answers to these questions enable decision-makers to develop appropriate strategies that strengthen trust between neighbourhood stakeholders and organisations prior to a hazard event (Paton, 2007b). For instance, people's ability to trust information coming from a government institution depends on prior experiences (Becker et al., 2011). Since hazard events are infrequent, it is essential to build trust through fair, inclusive, and empowering engagement with community members prior to a hazard event (Becker et al., 2011).

Social support

As discussed in Sections 7.4.1. and 7.4.2., social support enables participants to anticipate and cope with a range of circumstances, especially in a natural hazard event (e.g., Ganapati 2012). Research on social support demonstrates positive correlations between the pre-disaster frequencies of giving and receiving help and post-disaster levels of social support (Krz Kaniasty & Norris, 2000; Krzysztof Kaniasty & Norris, 1995). Key measures for this factor examine the frequency and perceptions of social support and assess conditions that enhance (or erode) levels of social support. These questions would address structural (e.g., demographic shifts) and cognitive forces (e.g., cultural beliefs) and identify solutions that foster social support expectations and behaviours.

Empowerment through collective action

Results from this study highlight the ability of neighbourhood stakeholders to come together in resolving community-wide challenges and meeting community needs. Empowerment, which refers to "citizens' capacity to gain mastery over their affairs and to deal with issues and opportunities using intrinsic resources" (Paton, 2007a, p. 34), is essential to the manifestation of collective action at the neighbourhood level. It is this capacity that plays an important role in community disaster resilience (Paton, 2007a). The study's social capital questions measure empowerment through assessing neighbourhood stakeholders' experiences, perceptions, and challenges to collective action. By understanding challenges to collective action, for instance, stakeholders can work with decision-makers at the neighbourhood and city levels to develop strategies to reduce barriers for people to work together.

7.6 Limitations and future research

While the measures proposed in this measurement framework are far from exhaustive, they serve as a starting point for neighbourhood-based DRR planning and evaluation process. The framework highlights the importance of capitalising the strengths of both quantitative and qualitative approaches to measuring social capital across different social capital types (i.e., bonding, bridging,

and linking) and dimensions (i.e., structural and cognitive). Quantifiable measures can provide a snapshot of existing levels of social capital in a neighbourhood, and open-ended questions give context to key challenges and opportunities that can be used for developing disaster resilience strategies and for tracking progress.

The extrapolation of key dimensions of social capital from focus group data is not without its limitation. First, the make-up of these focus group participants may not reflect all the different voices and perspectives that exist within a neighbourhood. Given that the focus groups were conducted in English, this study did not account for the perspectives of community members who are not fluent in English. Past studies have demonstrated that non-English speakers and those from minority cultures, such as refugees and non-English speaking immigrant groups, hold different perspectives pertaining to disaster preparedness and response, and employ unique strategies to buffer against hazard event impacts and recover from disasters (Chamlee-Wright & Storr, 2010; Eisenman et al., 2009; Marlowe & Lou, 2016). Future studies are needed to solicit the perspectives of communities who were not part of this research study. Second, the development of the proposed framework and measures was conducted by the study's primary author who brought his own interpretations and biases to the process. In resolving this problem, validation of the proposed social capital assessment framework and measures with neighbourhood stakeholders is needed. Future studies would, therefore, involve developing a process with neighbourhood leaders, community groups, and emergency management practitioners and policymakers at the city level to verify that the assessment framework and measures reflect their information needs and priorities. This process could also refine the assessment measures and implementation methods.

7.7 Conclusion

Although building social capital is widely acknowledged in neighbourhood-based resilience planning, putting them into practice requires understanding and contextualising local conditions and perceptions. This study illustrates the diverse perspectives of neighbourhood stakeholders on three issues – community demography, cultural influences on social support, and neighbourhood governance – that have shaped neighbourhood-based social connections and capacities in contributing to disaster resilience. The study's proposed measurement framework includes quantitative indicators and exploratory questions that guide neighbourhoods in baselining and setting performance targets for the levels, quality, and goals of social connections and capacities. These assessment measures reflect both common measures of social capital that could be applied across the study's research sites and be used to examine neighbourhood-specific influences. By synthesising the perspectives of neighbourhood stakeholders with those from the literature, this

study highlights the need for contextualising indicators derived from top-down approaches and reflects Gaillard and Mercer's (2013) argument that the integration and application of both scientific and local knowledge are essential to enhancing the resilience of communities. It is pertinent that stakeholders at the local level (i.e., neighbourhood stakeholders and emergency management practitioners) and at the city or regional levels (i.e., policy makers and researchers) are involved in the validation and implementation of resilience measures. Only then will resilience measurements and subsequent community-based DRR interventions be able to address the needs and build adaptive capacities of local communities.

7.8 Link to Chapter 8 – Discussion

The last three chapters (Chapters 5 to 7) present detailed results of this thesis through a series of published and submitted papers. Their key findings are summarised in the following chapter (Chapter 8 – Discussion). The next chapter also discusses future directions of disaster resilience research.

Chapter 8 – Discussion

8.1 Context

As natural hazard events continue to wreak havoc on nations and communities, building disaster resilience remains a priority across all levels of society (UNISDR, 2015b). One aspect of community disaster resilience that has received significant attention is resilience of the social environment, which has been found to facilitate disaster preparedness, response and recovery (Aldrich, 2012a; Burton, 2012; Johnston et al., 2011; Paton, Mamula-Seadon, et al., 2013). However, the wider emergency management sector has yet to fully realise the potential of social influences and factors in enhancing disaster resilience (Alshehri et al., 2015; Murphy, 2007). Recent disasters, such as Hurricane Sandy on the U.S. East Coast in 2012 and the Canterbury earthquakes in Christchurch, New Zealand, in 2011 and 2012, revealed gaps in how governments conceptualised and incorporated community-based social factors into their disaster response policy, planning and intervention efforts (Feuer, 2012; Montgomery, 2013). This omission means that a key group – that of community stakeholders – is being neglected in the development of comprehensive DRR policy and practice.

As local communities are on the frontline in preparing for and dealing with the aftermath of disasters, there is a growing recognition by emergency management agencies of the value of engaging community stakeholders in DRR efforts. In a workshop on assessing disaster resilience, questions such as “What do community members value?” continue to be raised by researchers, policymakers, and practitioners (National Academies of Sciences, Engineering, and Medicine, 2017, p. 21). This lack of understanding makes it important to measure disaster resilience in ways that accommodate the assessment of social resilience through different stakeholder perspectives. Some studies examine the concept of social resilience through the perspectives of community residents (Cox & Hamlen, 2014; Freitag et al., 2014), while others capture the perspectives of disaster risk reduction (DRR) practitioners (Khalili et al., 2015; Orencio & Fujii, 2013; Singh-Peterson et al., 2014). However, few research studies have examined and integrated the perspectives of these two groups. Thus, one knowledge gap that this thesis seeks to fill is the examination of how social resilience is conceptualised by multiple perspectives and how these perspectives can form the basis for the development of resilience assessment frameworks and measures. In order to cultivate resilience locally, it is essential that resilience assessment and planning draw on and bridge the expertise of scientific, government and community stakeholders (Gaillard & Mercer, 2013).

Another knowledge gap that this thesis addresses is developing resilience assessments through a participatory approach. Although there is an overall burgeoning of research and development of disaster resilience assessments, the incorporation of community input into assessment tools has yet to become standard practice. While community participation is considered to be essential to effective resilience planning (Horney, Nguyen, et al., 2016), substantial progress is needed in engaging local communities in the development of resilience assessments that can provide a holistic view of hazard risks, community vulnerabilities, and community capacities (Gaillard & Mercer, 2013). For example, only 36% of the 36 community resilience assessment tools reviewed by Sharifi (2016) used a participatory approach in their development process, while the rest were formulated through the use of literature and expert opinions. The latter top-down, technocratic assessment approach can result in a disconnect from the diverse values and priorities of the very people who would be most affected by disasters (Gaillard & Mercer, 2013; IFRC, 2016; Sharifi, 2016).

It is essential to develop resilience measures that are genuinely neighbourhood-based, so that DRR interventions are informed by and can effectively address local conditions. Developing a place-specific understanding can best be accomplished by ascertaining the views of community members about what they think contributes to their resilience. This process should assess not only the discrete features (i.e., structural dimension) of social resilience but also people's attitudes, values and beliefs (i.e., cognitive dimension) (Paton, Mamula-Seadon, et al., 2013; Uphoff, 1999). To address the structural and cognitive dimensions of disaster resilience of the social environment, resilience measures need to be grounded in the experiences and perspectives of neighbourhood stakeholders.

This PhD research project addresses existing gaps in the literature on baselining neighbourhood disaster resilience levels by asking the following primary research question:

How can social resilience to disasters be measured at the neighbourhood level?

To answer this overarching research question, this research project addresses several sub-questions:

- How is disaster resilience currently being conceptualised and measured in the literature?
- What is social resilience? How is social resilience defined by different stakeholder groups that include researchers, policymakers, practitioners, and neighbourhood stakeholders?
- How do underlying contextual influences shape the perspectives of social resilience?
- Based on the perspectives of these stakeholder groups, what are the common features and characteristics of social resilience?
- What assessment measures can be identified to reflect the diverse perspectives and common features of social resilience?

8.2 Summary of research undertaken

A qualitative methodological approach was used to answer the research questions. As discussed previously, many existing neighbourhood-based resilience assessments are rooted in quantitative methods that reduce disaster resilience to a score, rank, or other forms of numerical calculation. This reductionist approach overlooks the diversity of beliefs, capacities, and needs that exists in communities. Therefore, a qualitative approach to data collection was chosen for this thesis to allow for in-depth descriptions that reflect the diversity of neighbourhood-based interactions and perspectives, expand on the different methodological approaches in the development of neighbourhood-based resilience assessments, and, more importantly, address existing knowledge gaps in participatory assessment development. Furthermore, examining the different perspectives of stakeholder groups provides the ability to derive their common and neighbourhood-specific characteristics of social resilience.

To advance the field of research in disaster resilience measurements, this research used an appreciative inquiry (AI) methodology, a form of action research that is oriented toward the idea that social life and structures are constructed through relational interactions (Zandee & Cooperrider, 2008). It is a participatory research methodology that embraces the diverse perspectives of disaster resilience and focuses on the application and implementation of disaster resilience measures. AI sits squarely within the qualitative paradigm of research and approaches the topic of research through open and exploratory questions with the aim of discovering perspectives and values of everyday life (Watkins et al., 2011).

This research comprised two primary data collection methods: one structured workshop with 13 hazard researchers, emergency management practitioners, and a policymaker, and nine focus groups with 58 participants from five neighbourhoods in the Wellington region, New Zealand (i.e., Brooklyn and Cannons Creek), and San Francisco, U.S. (i.e., Bayview, Chinatown, and Miraloma Park). These two regions face many natural hazards and share a similar risk profile for earthquakes; both regions experienced strong earthquakes historically and in recent times. In the Wellington region, two successive earthquakes in Cook Strait (M6.5) and Grassmere (M6.6) within a one-month period in 2013 resulted in minor damage to buildings in the city of Wellington. The San Francisco Bay Area experienced a large earthquake (M6.0) in 2014 near the Napa Valley. While no damage was reported in the City and County of San Francisco, the earthquake was the largest in the area since the 1989 Loma Prieta earthquake that did cause major damage to the city.

This research was conducted approximately two years after those earthquakes and shortly after both the city of Wellington and the City and County of San Francisco were selected to be part of the

100 Resilient Cities programme. These influences provided a research setting where the research topic under investigation was salient to various stakeholder groups. The structured workshop and focus groups were digitally audio-recorded with the consent of participants. Recordings were transcribed and processed using NVivo. Transcripts were first coded and then categorised into themes. These themes formed the basis for social resilience measurements of neighbourhoods.

8.3 Results of research question and aim

This section summarises findings for the thesis's research questions.

8.3.1 Conceptualisation of and approaches to measuring disaster resilience

The first question of this thesis is, "*How is disaster resilience being conceptualised and measured?*" The conceptualisation of disaster resilience in the literature is diverse, as it stems from various epistemological and theoretical orientations (Cutter et al., 2014). A review of the literature pointed to several strands of conceptual thinking. Disaster resilience can be viewed as a specific societal process, such as community governance, which focuses on decision-making systems and procedures (Matyas & Pelling, 2012). It can also focus on responses of societal systems to a specific type of hazard, such as an earthquake (Bruneau et al., 2003) or a meteorological event (Joerin et al., 2012).

A more dominant conceptualisation of disaster resilience is through the lens of societal capitals or dimensions, such as social, cultural, political, economic, human, physical, and/or natural resources (Mayunga, 2009; Miles, 2015; Renschler et al., 2010; Ritchie & Gill, 2011). Increasingly, the concept of disaster resilience is seen holistically through a multi-scalar and multi-phase approach as having not only various societal dimensions and processes, but also spanning spatial and temporal scales (Cutter et al., 2008a; Paton & Johnston, 2017; Tobin, 1999).

The conceptualisation of community disaster resilience by various stakeholder groups in this research aligned with those found in the literature. For instance, experts in the workshop identified several attributes that facilitate community disaster resilience, including community governance, knowledge of hazard risks, community assets and gaps, availability of resources, and a strong and connected network of social and institutional relationships (Chapter 5).

Overall, neighbourhood stakeholders' framing of community disaster resilience touched on:

- Scales across individual, household, neighbourhood, and societal levels that are spatial (e.g., proximity between neighbourhoods and to hazards) and temporal (e.g., preparedness, response, recovery)

- Type of hazards, including human-induced stresses (e.g., crime) and natural hazards (e.g., earthquakes)
- Environmental characteristics that are socio-cultural (e.g., social connectedness), economic (e.g., diversity and robustness of community-based businesses), institutional/governance (e.g., disaster plans), and built (e.g., lifelines and places of residence)
- Processes that contribute to resilient characteristics, including community engagement and sense of adaptiveness and collective efficacy – that is, the belief that a community can do something to control the outcome of a disaster
- Outcomes that reflect conditions of a resilient community, including population retention and resumption of community functions

Collectively, participants in this research offered a conceptualisation of resilience that is multi-scalar and multi-dimensional, reflecting the need for operationalising and measuring the concept that takes into consideration a range and interdependencies of resilience attributes.

The operationalisation and measurement of disaster resilience is as diverse in the literature as is the conceptualisation of it (Cutter, 2016; Ostadtaghizadeh et al., 2015). The three main approaches to measuring disaster resilience are quantitative, qualitative, and participatory (Gaillard & Jigyasu, 2016). Quantitative approaches are generally nomothetic (top-down), whereby large quantitative datasets are used to compare across various units of analysis (Cutter, 2016). Qualitative and participatory approaches are idiographic (bottom-up) and result in place-specific measures (Cutter, 2016).

While qualitative and participatory approaches are increasingly recognised as essential to building community disaster resilience (Horney et al., 2016; Pfefferbaum et al., 2015), few existing tools have engaged local stakeholders in their development and implementation (Sharifi, 2016). This thesis's use of a qualitative, participatory process resulted in a measurement framework that is applicable for assessing social resilience of the study's neighbourhoods.

8.3.2 Defining social resilience through multiple perspectives

The second question, "*How is social resilience defined by different stakeholder groups that include researchers, policymakers, practitioners, and neighbourhood stakeholders?*" addresses the conceptualisations of social resilience by different groups, with the objective of identifying common and contextual features and characteristics of the concept.

As discussed previously, understanding and integrating different stakeholder perspectives (i.e., local and scientific or expert) on disaster resilience is essential to the development of resilience policies and interventions that are tailored to local needs and accommodate the diverse ways in which

neighbourhoods deal with natural hazard events. Gaining such understanding requires agencies to engage with neighbourhood stakeholders to identify what resilience means to them, as well as to measure and develop resilience in multiple ways in order to bring about the potential for effective DRR assessments, planning, and interventions (Davies et al., 2015; Gaillard & Mercer, 2013).

As governments and local agencies seek to cultivate community disaster resilience, emergent research in disaster resilience assessment and planning has focused on the concept of social resilience as it relates to influencing and predicting the recovery trajectories of people and communities (Aldrich, 2010, 2011b; Burton, 2014; Cox & Perry, 2011; Johnston et al., 2011; Paton et al., 2014; Paton, Mamula-Seadon, et al., 2013; Tatsuki, 2007). As a component of community disaster resilience, social resilience is multifaceted and multidisciplinary. Much of the sociological perspective's contribution to social resilience thinking stems from research on social capital from the likes of Bourdieu, Putnam and Coleman (Portes, 1998). Psychological research studies emphasise the perceptions and attitudes of people's environment by focusing on concepts such as a sense of community, trust, self and community efficacy (Paton & Johnston, 2006). Political science research contributes to the discourse through its emphasis on political systems and attributes such as governance, leadership, and decision-making processes (Comfort, Boin, & Demchar, 2010). Climate change scientists explore the interdependencies between social and natural environments (or socio-ecological systems) (Adger, 2000). Meanwhile, geographers seek to examine disaster resilience through the interactions of social resilience factors at different spatial and temporal scales (Cutter et al., 2008a). These academic perspectives, while not exhaustive, serve to highlight the complexity inherent in social resilience research since social units and systems are dependent on the functions of other societal systems such as the economic environment (Rose, 2007), physical infrastructure (e.g., Chang & Shinozuka, 2004), and ecosystem services (e.g., Berke et al., 2008).

Building on these scholarly works, the two research projects of this thesis investigated the multidimensional nature of social resilience by examining the perspectives from two stakeholder groups: experts (i.e., hazard researchers, emergency management practitioners, and a policymaker) and neighbourhood stakeholders. Summaries of these two sets of perspectives are described next.

8.3.2.1 Defining social resilience: Perspectives from hazard researchers, emergency management practitioners, and policymakers

In the workshop with researchers, practitioners, and a policymaker, social resilience was framed as consisting of 'social strengths' which entail community resources and processes that pertain to the social environment (Morrow, 2008). Workshop activities sought the perspectives of experts about

the four categories of social resilience: skills, abilities, and knowledge; community qualities and amenities; community values and perceptions; and community processes.

Collectively, workshop participants identified 66 unique attributes across the four categories of social resilience. The most frequently mentioned attributes included *community gathering place*, *social support*, *knowledge of risks and consequences*, *collective efficacy*, and *sense of community*.

By synthesising the perspectives of these experts with those found in the literature, a set of social resilience measurement themes was proposed (Table 5.9 in Chapter 5) (Kwok et al., 2016). These themes span both cognitive and structural dimensions and relate to social resilience attributes that include:

- Adaptability – ability to embrace change
- Collective efficacy
- Community inclusiveness
- Connectedness between networks
- Leadership
- Sense of community and attachment
- Shared community beliefs and values
- Social support
- Trust
- Access to economic resources
- Community (and individual) preparedness
- Democratic and collaborative decision-making, and problem-solving policies and processes
- Disaster management planning
- Diversity of skills and trained personnel
- Knowledge of community assets and beliefs
- Knowledge of hazard risks and hazard consequences

While these themes can serve as a foundation for assessing the social resilience of communities, their relevance and applicability to a specific neighbourhood requires validation from the perspectives of neighbourhood stakeholders. The next section discusses the viewpoints of neighbourhood stakeholders studied here.

8.3.2.2 Defining social resilience: Perspectives from diverse neighbourhood stakeholders

Building on findings from the workshop, focus groups were conducted with stakeholders across five neighbourhoods in the Wellington and San Francisco regions. The objectives of the focus groups were to investigate local stakeholders' perceptions of community disaster resilience, identify common and unique neighbourhood-specific resilience factors, and, based on their responses,

develop a framework for measuring social resilience of neighbourhoods. This section summarises how neighbourhood stakeholders conceptualised the social resilience of their neighbourhoods.

Focus group participants were asked about attributes that pertain to the four categories of social resilience: skills, abilities, and knowledge; community qualities and amenities; community values and perceptions; and community processes. Thematic analysis of participants' perspectives showed that social resilience attributes, similar to those identified by workshop participants, span across various societal domains, including individual/psychological, socio-cultural, economic, infrastructural/built, and institutional/governance. These themes were presented in Table 6.6, Chapter 6, and are listed as follows:

- Individual responsibility
- Psychological well-being
- Self-efficacy
- Awareness of hazard risks
- Awareness of vulnerabilities of people and structures
- Collective efficacy
- Community participation
- Cultural values and practices
- Education and training
- Information and communication
- Learning from past hazard events (locally or elsewhere)
- Place attachment
- Diversity of skills
- Social networks
- Social responsibility
- Stability of population
- Understanding potential hazard impacts and consequences
- Economic resilience of individuals and communities
- Neighbourhood space and amenities
- Structural integrity of buildings and infrastructure (e.g., roads) and lifelines
- Civic infrastructure
- Experiences and effectiveness in collective action
- Unifying leadership
- Inclusiveness
- Community planning

The two sets of perspectives – experts and neighbourhood stakeholders – revealed similarities in how social resilience was conceptualised by these two groups. This might be due in part to the fact that half of the focus group participants were trained in or had been involved in disaster planning

and response, shifting the aggregated responses of neighbourhood stakeholders toward an understanding of resilience assets and gaps.

This study highlighted that neighbourhood stakeholders possess knowledge about neighbourhood assets, gaps, dynamics, and conditions. Their informed responses demonstrate the need to incorporate the knowledge and diverse perspectives of neighbourhood stakeholders in disaster resilience planning. The integration of local perspectives is essential to achieving shared DRR responsibilities between governments and communities. Furthermore, neighbourhood stakeholders need to be provided with access to opportunities to actively participate in key decision-making processes, rather than be passive participants where their knowledge is extracted (Gaillard & Jigyasu, 2016).

The engagement of stakeholders from underrepresented communities is particularly important as they are most vulnerable to the consequences of disasters (Blake & Lyons, 2016; Wisner et al., 2004). This research study had a limitation in that several community segments were not represented in focus group sessions, including the business sector, individuals who do not speak English, and hard-to-reach individuals. It is essential that community-based disaster planning builds an inclusive environment to ensure full participation.

8.3.3 Social resilience measurement framework: Common features and characteristics

By drawing upon the perspectives of two different stakeholder groups, this thesis addresses the fourth research question: "*Based on the perspectives of these stakeholder groups, what are the common features and characteristics of social resilience?*"

Similarities in the conceptualisation of social resilience by different stakeholders point to opportunities for operationalising the concept within the context of resilience measurements. This section discusses the integration of the different perspectives based on the common features and characteristics of social resilience across structural and cognitive dimensions and societal domains.

Table 8.1 combines the key measurement themes from the two frameworks presented in previous Chapters (Table 5.9, Chapter 5 (Kwok et al., 2016) and Table 6.6, Chapter 6 (Kwok, Paton, et al., 2018)). Themes that are in bold represent the shared features between these two sets of perspectives, themes in plain (unbolded) text reflect measurement themes based on the results from neighbourhood-based focus groups, and themes that are italicised are from the perspectives of hazard researchers, emergency management practitioners, and policymakers. Several of these shared themes were renamed to reflect a synthesis of thematic categories.

Table 8.1 *Shared features of social resilience from the perspectives of experts and neighbourhood stakeholders, in bold*

Category	Cognitive	Structural
Individual/ psychological	Psychological well-being Self-efficacy	**Individual responsibility**
Socio-cultural	*Adaptability – ability to embrace change* **Collective efficacy** Community participation **Sense of community and place attachment** **Social networks** *Trust*	Awareness of vulnerabilities of people and structures **Diversity of skills** **Education and training** Information and communication Learning from past hazard events (locally or elsewhere) *Social support* Stability of population **Understanding potential hazard risks, impacts and consequences**
Economic		**Access to economic resources by individuals and communities**
Infrastructural/ built		Neighbourhood space and amenities Structural integrity of buildings and infrastructure (e.g., roads) and lifelines
Institutional/ governance	Experiences and effectiveness in collective action **Decision-making Inclusiveness** **Unifying leadership**	Civic infrastructure **Community responsibility and disaster planning**

Bold: Social resilience measurement themes that are shared across hazard researchers, emergency management practitioners, policymakers, and neighbourhood stakeholders.

Plain: Social resilience measurement themes based on results from neighbourhood-based focus groups

Italicised: Social resilience measurement themes based on results from a workshop with hazard researchers, emergency management practitioners, and policymakers.

While resilience characteristics within each category are interdependent, the following sections (8.3.3.1 to 8.3.3.11) briefly discuss each of the shared characteristics as they relate to disaster resilience, along with action steps that can cultivate them at the neighbourhood level.

8.3.3.1 Individual responsibility

One of the building blocks of community disaster resilience is the need to cultivate individual responsibility, which centres on an individual's understanding of their risk to hazard events and developing their risk management and preparedness activities so they can manage their risk and the consequences they could experience from natural hazards events (Becker et al., 2012; Paton & McClure, 2013). One of the biggest impediments to successful disaster recovery for individuals is their lack of preparedness (Paton, Anderson, Becker, & Petersen, 2015). Obstacles to being prepared include cognitive barriers such as denial of hazard risks, low sense of self-efficacy (that is, the belief that they can do something about the outcome of a disaster), lack of trust in hazard communication coming from government agencies, financial or other resource constraints that deter preparedness

efforts, lack of clarity in disaster information, and linguistic and cultural barriers (Becker, 2012; Eisenman et al., 2009).

To address these barriers, it has been recommended by Becker et al. (2011) and Eisenman et al. (2009) that preparedness education and training be designed to increase people's critical awareness of hazard risks, cultivate people's self-efficacy, build trust between people and governments, offer support and resources for those who are unable to carry out disaster preparedness planning, and provide culturally and linguistically appropriate preparedness information and resources. These strategies are further discussed in Sections 8.3.3.7 and 8.3.3.8.

8.3.3.2 Community responsibility and planning

Building on individual responsibility is the collective responsibility of communities to plan for all phases of a disaster. Having a community-wide plan allows for the identification of existing and potential service gaps and assets (e.g., housing, social welfare for vulnerable populations), defining disaster management responsibilities, refining communication and logistical processes among community-based and government entities and emergent groups, and planning for long-term recovery and the return of community functions (Freitag et al., 2014; Olshansky et al., 2008; Paton & Johnston, 2006). As noted by Olshansky (2006), disaster survivors will rebuild their lives one way or another, and it is important that local governments take an active role in ensuring the effectiveness (e.g., speed and quality) of disaster response and recovery activities. The responsibility for developing community-wide plans should rest on community members and local governments, so that disaster management roles and responsibilities, as well as the complementary capabilities of diverse stakeholders, can be articulated and operationalised (UNISDR, 2015b).

8.3.3.3 Collective efficacy

Collective efficacy describes the perceptions of a community's ability to work together in overcoming challenges and their ability to assess their capabilities and articulate their resource needs (Paton et al., 2009). Within the disaster context, collective efficacy is linked to community disaster resilience (Norris et al., 2008; Paton et al., 2014). High levels of collective efficacy facilitate disaster preparedness (Lindell & Whitney, 2000; McIvor, Paton, & Johnston, 2009), response (Paton et al., 2014), and recovery (Paton & Jang, 2016). For instance, following the 2011 Christchurch earthquake, neighbourhood groups that had endured the early stages of disaster response by collaboratively meeting the survival needs of residents were able to develop the necessary skills to adapt, problem-solve, and plan for their recovery (Paton & Jang, 2016).

As demonstrated in this thesis, all neighbourhoods displayed their capacity to work toward a common good, such as supporting each other emotionally during the loss of influential community members and helping neighbours during a flood. These and similar instances reiterate the importance of cultivating the collective belief that community members can make the necessary changes and secure appropriate resources to address challenges that arise during the course of a disaster. Strategies for increasing levels of collective efficacy include encouraging residents to volunteer (as it enhances people's ability to problem-solve) and empowering community-based organisations and residents to engage in government decision-making that affects their communities (Paton et al., 2014).

8.3.3.4 Cultural values and practices

As this thesis illustrates, cultural beliefs and practices (based on race and ethnicity) shaped neighbourhood stakeholders' perspectives on resilience-enabling and resilience-impeding factors. While race, ethnicity, and culture play a significant role in hazard risk perception and preparedness (Baker & Cormier, 2015; Elder et al., 2007; Senkbeil, Scott, Guinazu-Walker, & Rockman, 2014), the emergency management sector has been slow to consider these factors in many disaster planning and recovery programmes. This has hampered individual and community resilience and perpetuated social vulnerabilities (Cutter et al., 2006; Elder et al., 2007; Kenney & Phibbs, 2015; Lin & Lin, 2016; Tierney, 2012). For example, while the Māori-led community disaster management response and recovery to the Christchurch earthquakes were collaborative and highly effective in addressing the needs of residents, there was a lack of engagement, coordination, and support by formal emergency management agencies (Batt, Atherfold, & Grant, 2011; Kenney & Phibbs, 2015). The delayed coordination between Māori-led and government disaster management efforts resulted in duplication or the absence of services in some regions and hindrance in the deployment of Māori medical teams by formal authorities (Batt et al., 2011; Kenney & Phibbs, 2015). Perceived and actual racial inequality in disaster management responses by local government agencies and personnel were also found to have created barriers for racial minorities from taking protective actions (e.g., evacuation) during Hurricane Katrina (Elder et al., 2007). Unfortunately, underlying systemic racism in disaster management actions is not easily rectified in local DRR planning.

While racial inequality in disaster management cannot be eliminated simply through local DRR planning, DRR planning can certainly engage and be made more accessible to members of ethnic, cultural, and marginalised groups (Blake, Marlowe, & Johnston, 2017). For instance, a study in the U.S. by Eisenman et al. (2009) found that Spanish-speaking residents face significant challenges in obtaining disaster preparedness resources. Results of this research highlight that resources need to

be delivered through trusted avenues and in languages spoken by residents. In the case of Latino immigrants in the U.S., Eisenman et al. (2009) recommend that disaster preparedness resources be created in Spanish and delivered by well-established and trusted networks of lay health workers (*promotoras de salud*). As local governments are increasingly working with communities to enhance residents' resilience in a pre-disaster environment, concerted efforts to increase the cultural appropriateness of existing policies, planning process, and programmes are needed.

8.3.3.5 Diversity of skills

A neighbourhood that has a diversity of skillsets contributes to improved neighbourhood governance and provides more effective disaster response and recovery outcomes. Generalised skillsets such as leadership and problem-solving, along with functional skillsets such as emergency response skills (e.g., CPR, basic triage) and physical skills (e.g., building and repairing) are critical to community disaster resilience (Becker at al., 2013; Goodman et al., 1998; Purdue, 2001; Wisner & Adams, 2002).

To ensure that there is a diversity of skillsets at the neighbourhood level, two strategies should be adopted. First, neighbourhood-based organisations and groups can inventory available skills and assets in the community, so they can activate them quickly in a disaster situation (Intergovernmental Panel on Climate Change, 2012; UNISDR, 2014). Through the identification of existing skills and assets, a community can then develop appropriate training opportunities and partnerships with outside groups and organisations to address skills gaps. Second, increasing access (e.g., language access) to existing leadership capacity building programmes and community-based response trainings – such as CERT (Citizen Emergency Response Training) – can foster social connections while building new skills for local residents (Kapucu, 2008).

8.3.3.6 Economic resources

Economic resilience was identified both by workshop and focus group participants as a contributor to social resilience. Specifically, participants conceptualised economic resilience at an individual level (e.g., income and access to emergency funds) and at the community level (e.g., vitality of local businesses). This conceptualisation aligns with existing research that stresses the importance of available livelihood opportunities, equitable distribution of or access to resources, and robust economic activities or diversity (Adger, 1999; Norris et al., 2008).

While many economic challenges are structural in nature (e.g., poverty) and are often beyond the control of neighbourhoods, interventions that target neighbourhood-level economic problems, such as workforce training (Olshansky, 2006) and local hiring practices (San Francisco Office of Economic and Workforce Development, 2010) can improve the economic conditions of individuals,

households, and communities. Thus, policies developed at the city and regional government levels need to address the allocation of funding that supports these local interventions, which in turn support other social aspects of disaster resilience.

8.3.3.7 Education and training

It does not come as a surprise that a key to building community disaster resilience is educating and training residents about hazard risks and ways to be prepared and to respond (Feng, Hossain, & Paton, 2018; Paton, 2013; Paton & McClure, 2013; Weichselgartner & Pigeon, 2015). As discussed in Section 8.3.3.1., DRR education and training should focus on increasing people's critical awareness of hazard risks, cultivating self-efficacy and collective efficacy, building trust between residents and government entities, offering opportunities for securing resources and support, and addressing the cultural and linguistic needs of residents.

First, increasing people's critical awareness of hazard risks so they think about and discuss hazard issues more frequently is shown to enhance disaster resilience (Becker et al., 2011; McIvor & Paton, 2007). Strategies that enhance critical awareness are further discussed in Section 8.3.3.8. Second, cultivating people's self-efficacy and collective efficacy directly influences individual preparedness and community resilience levels (Becker et al., 2011; Lindell & Whitney, 2000). Education and training should stress the importance of appraising existing individual and collective skills, knowledge, and resources in an inclusive setting.

Third, people learn about hazard risks through various sources. The perceived credibility of hazards information is based on people's trust of their sources, which are predominately civic institutions (Paton, 2007b). It follows from the preceding discussion that building community disaster resilience requires increasing the level of trust that people have in their civic institutions such as government agencies. This is done by ensuring that their daily interactions with these agencies are competent and inclusive (Becker et al., 2011).

Fourth, material and non-material resources (e.g., money, neighbourhood volunteers, social support) facilitate individual and community disaster resilience (LaLone, 2012; Norris et al., 2008; Paton & McClure, 2013). Such resources are especially important to those who are most vulnerable to disasters, including people with disabilities, with mental health and substance issues, without shelter, and without the ability to speak English (Baker & Cormier, 2015; Blake & Lyons, 2016; Cutter et al., 2003; Marlowe & Lou, 2016; Senkbeil et al., 2014; Zakour, 2010). Thus, governments should allocate the necessary resources to community-based organisations to better support those who are least likely to be prepared. As discussed in 8.3.3.4., creating culturally and linguistically accessible

resilience interventions is key to an equitable approach to building community resilience for all residents.

8.3.3.8 Understanding potential hazard risks, impacts, and consequences

Understanding potential hazard risks, impacts, and consequences involves people's critical awareness of such risks and outcomes. Critical awareness is the extent to which, under normal and pre-disaster circumstances, people think and talk about certain hazards that they perceive as critical or salient (Kloos, Thomas, Wandersman, Elias, & Dalton, 2012; Paton, 2003). However, research shows that having awareness of hazard risks is not enough to drive people to take preparedness actions (Paton, 2003). Rather, it is the frequency in which people think and talk about a hazard issue that is shown to enhance preparedness levels to potential hazards (Becker et al., 2011; McIvor & Paton, 2007).

To cultivate people's critical awareness, various strategies need to be adopted that would lead to their intention to prepare and to actual preparation itself (Paton, Smith, & Johnston, 2005). One strategy is to create discussion and learning opportunities that encourage people to share their experiences in dealing with and preparing for disasters, and making hazard-related conversations a more frequent topic of discussion in community-wide settings (Becker et al., 2011). Other strategies include cultivating and enhancing people's engagement in community events and affairs and increasing their rate of volunteerism, as these activities increase their awareness of not only everyday community issues, but also of hazard risks when risk information is disseminated (Becker, 2012; Paton et al., 2014)

8.3.3.9 Leadership and inclusiveness in decision-making

As discussed previously, having active leaders who can represent the various voices within a neighbourhood is essential to positive disaster recovery outcomes (Paton, Mamula-Seadon, et al., 2013). As the Sendai Framework asserts, "governments should engage with relevant stakeholders, including women, children and youth, persons with disabilities, poor people, migrants, indigenous peoples, volunteers, the community of practitioners and older persons in the design and implementation of policies, plans and standards" (UNISDR, 2015b, p. 10). Their engagement is seen by DRR practitioners as a priority in the development of resilience interventions as many of these population groups are most susceptible to the consequences of natural hazard events (Wisner et al., 2004).

Thus, developing and scaling up leadership capacity building programmes, such as San Francisco's Neighbourhood Empowered Network's empowered communities programme (Neighborhood

Empowerment Network, 2014), is integral to enhancing community disaster resilience. It is especially important that vulnerable populations have access to such trainings and planning processes. More often than not, community stakeholders and leaders who are involved in the planning process possess prerequisite levels of resources and power that enable them to participate in the first place, while those who are vulnerable or hold little influence in community decisions are excluded (Farrington & Bebbington, 1993). Therefore, ensuring that hard-to-reach and underserved segments of the population are engaged in community-wide DRR planning process is essential to their resilience and to overall community resilience (Blake & Lyons, 2016).

8.3.3.10 Sense of community and place attachment

Sense of community is a general concept that refers to attitudes of belonging in a group or a locale, including shared values and concerns with other members (Norris et al., 2008; Perkins, Hughey, & Speer, 2002). It captures a narrower concept of place attachment, which is the positive emotional bond between people and their environment (Chamlee-Wright & Storr, 2009b). A high level of sense of community and place attachment is a predictor of community disaster resilience (Norris et al., 2008). Place attachment facilitates people's engagement in collective efforts to improve their neighbourhoods (collective efficacy), and encourages them to rebuild in a post-disaster environment (Brown et al., 2003; Chamlee-Wright & Storr, 2009b; Manzo & Perkins, 2006). For example, Chamlee-Wright and Storr (2009b) found that sense of place and place attachment were important factors in determining whether displaced residents returned to their neighbourhoods after Hurricane Katrina in New Orleans. The study found that those who were not able to return to New Orleans were more likely to experience a sense of powerlessness in recreating their pre-Katrina life.

To maintain or enhance people's sense of community and place attachment, local government policies need to focus on conditions that facilitate their development, including promoting length of residence in the neighbourhood and encouraging homeownership (Brown et al., 2003). At the neighbourhood-level, ensuring that community activities are frequent and inclusive can also enhance people's connections to place-based groups and neighbourhoods (Okada et al., 2010).

8.3.3.11 Social networks

Community-based informal and formal networks serve to catalyse preparedness, response, and recovery actions (Aldrich, 2012a; Becker et al., 2017; Bihari & Ryan, 2012; Graham et al., 2016; Nakagawa & Shaw, 2004). While this dimension has been described thoroughly in Chapter 7, the cultivation of social networks should not be focused exclusively on DRR. Support of non-DRR interventions that enhance social networks is just as important to community disaster resilience. For

instance, community gardens (Colding & Barthel, 2013), social media networks (Paton & Irons, 2016), and other types of informal social networks can facilitate the development of social capital that can be activated in a disaster. Increasingly, emergency management agencies are adopting a community-development approach to building disaster resilience. For instance, WREMO leads various community development projects (e.g., developing community gathering spaces) and supports community-led initiatives that do not have direct linkages to DRR but do indirectly in that they enhance overall social connectedness within neighbourhoods (Wellington City Council, 2017). The community development approach to DRR provides opportunities for communities to become empowered to take proactive steps toward disaster resilience.

8.3.4 Contextual influences shaping the perspectives of social resilience

While the common denominators of social resilience across different perspectives (as described in Section 8.3.3) are useful in forming resilience assessment frameworks and measures for neighbourhoods, context matters. To develop resilience assessment measures that reflect local conditions and dynamics, one of the research questions sought to identify the contextual influences that shaped the perspectives of social resilience. This section summarises research findings to the question, "*How do underlying contextual influences shape the perspectives of social resilience?*"

This thesis identifies several contextual influences, including social infrastructures and cultural norms, that facilitated the development and maintenance of social resilience factors such as a sense of community and social connectedness in the neighbourhoods under study. As espoused by DRR practitioners and neighbourhood stakeholders, knowing one's neighbours is essential to community disaster resilience (Herbst & Yannacci, 2013). The goal to build more connected neighbourhoods, as this research found, is influenced and reinforced by neighbourhood-specific social and cultural infrastructures (Kenney & Phibbs, 2015), such as religious institutions, schools, community-based organisations, residents' associations, as well as by community demographics. Furthermore, external influences, such as economic forces, were identified to impact neighbourhood-based social connectedness. For example, demographic changes in Bayview (San Francisco) were perceived to disrupt a place-based social fabric that had been developed over generations.

These findings reinforce the need to understand the factors that shape the extent of social resilience in each neighbourhood such as intersections of neighbourhood-based civic infrastructures (Becker et al., 2012; Graham et al., 2016), embedded cultural influences within social networks (Kaniasty & Norris, 2000; Paton, Bajek, et al., 2010; Paton & Jang, 2016; Paton, Okada, et al., 2013), and external influences such as the effects of residential tenure on local social networks (Brown et al., 2003).

Community resilience assessments should address these dynamics to help inform the development and evaluation of disaster resilience interventions.

8.3.5 Measuring neighbourhood-level social capital

The manuscript presented in Chapter 7 seeks to operationalise the concept of social capital, one of the social resilience measurement themes. It addresses the last sub-question of this research: "*What assessment measures can be identified to reflect the diverse perspectives and common features of social resilience?"*

The integrated social resilience assessment frameworks presented in Section 8.3.3. (Table 8.1), while quite broad in its scope, provide guidance for the benchmarking of and opportunities for understanding underlying contextual forces that drive the social resilience of neighbourhoods. One way to narrow the scope of resilience assessment is to prioritise and refine the attributes that reflect the actual needs and priorities of stakeholders and local decision-makers within each neighbourhood. While this approach could not be carried out here due to the scope of this research, another strategy was available: to refine a subset of social resilience attributes that have linkages to other social resilience factors. One social resilience component that permeates throughout the social resilience assessment framework is social capital – that is, resources embedded in one's social networks (Lin, 2008). A focus on social capital offers an opportunity to exercise a process of developing localised assessment measures that reflect the context and dynamics of neighbourhoods.

Social capital is embedded in formal and informal relationships and is activated in many daily situations. The activation of social capital has been extensively studied within the context of disasters (e.g., Aldrich & Meyer, 2014; Collins, Ersing, Polen, Saunders, & Senkbeil, 2018). Although social capital can enhance disaster resilience, it can also be used to exclude certain groups from accessing and sharing essential post-disaster resources, especially when social capital resources are concentrated within a social network that is closed to outsiders (Aldrich, 2011a; Ganapati, 2013). Thus, it is important that any resilience planning that seeks to cultivate neighbourhood-level social capital addresses this potential challenge.

As discussed throughout this thesis, the development of resilience measures can used as a tool for empowerment (i.e., using a bottom-up approach) or disempowerment (i.e., using a top-down approach). Additionally, although social capital measurements have been developed for assessing various phenomenon across various disciplines, their application within the disaster context is still nascent (Australian Red Cross, 2012). Therefore, this research study advances the development of social capital measures for disaster resilience by integrating the perspectives of neighbourhood

stakeholders, as their engagement in the measurement development process is essential to understanding neighbourhood-based dynamics and conditions that hinder or facilitate the cultivation and activation of social capital resources.

Focus group findings revealed the importance of social capital in building neighbourhood resilience and cautioned against influences that degrade its strength and quality. Three overarching themes were identified that underpin the perceived formation, activation, and outcomes of different dimensions of social capital: community demography, cultural influences on social support, and neighbourhood governance (Chapter 7).

First, community demography relates to the length of residence (tenure) and demographic changes in a neighbourhood. Results showed that neighbourhood stakeholders in focus groups believed in the importance of homeownership and long residential tenure for cultivating and maintaining social capital. Threats to social capital included the presence of short-term renters and the displacement of long-term residents due to gentrification.

Second, cultural influences on social support include both the normative value of neighbourliness and a shared sense of cultural connections and beliefs that are rooted in participants' race or ethnicity. The former stresses the importance of neighbourliness or 'neighbours helping neighbours' across a range of situations, from dealing with everyday stresses to preparing for and responding to disasters. The latter was particularly evident in focus group discussions that were held in Chinatown, Bayview, and Cannons Creek, which have a more homogenous demographic consisting of high numbers of racial or ethnic minorities. Again, rapid demographic changes were among the threats to neighbourliness and a shared sense of cultural connections and beliefs.

Third, neighbourhood governance refers to the perceived importance of residents and community-based organisations (CBOs) working together to deal with community-wide challenges and to advocate residents' needs to local decision-makers. While all neighbourhoods in this research possessed formal and informal CBOs, results suggested that the ability of each neighbourhood to advocate for its collective needs was based on the inclusiveness of its local leaders and decision-making process. The effectiveness of CBOs and neighbourhood-wide advocacy could be threatened by a leadership and decision-making process that did not represent the diverse needs and participation of a neighbourhood's entire community.

Social capital assessment measures that are based on these three themes – community demography, cultural influences on social support, and neighbourhood governance – were proposed

in Table 7.6 in Chapter 7. These measures pertain to the following measurement constructs across cognitive and structural dimensions, as well as across bonding, bridging, and linking social capital:

- Population stability
- Neighbourhood-based organisations and groups
- Coordination between community-based organisations
- Linkages to cultural and ethnic minority communities
- Presence and effectiveness of neighbourhood leaders and CBOs
- Inclusive and transparent government processes
- Cultural beliefs and expectations
- Trust
- Social support
- Empowerment through collective action

These constructs, along with a set of quantitative and qualitative measures, were discussed in detail in Chapter 7. The constructs and measures provide practitioners and neighbourhood stakeholders with the ability to take a snapshot of existing levels of social capital in a neighbourhood and gather the necessary contextual information to help inform the development of neighbourhood-specific resilience plans and interventions. This framework can have the potential for eliciting dialogue between different stakeholder groups and unearthing group values, assumptions of different groups, and group priorities concerning ways to develop community disaster resilience. More importantly, such dialogues in a post-disaster environment could bring about more effective recovery activities that are supported by communities. As noted by Vallance (2011a), social capital is vital to building bridges between neighbourhood and government stakeholders in times of stress, so that solutions to post-disaster challenges can be developed that meet the needs of both sides.

As discussed throughout this thesis, community engagement is essential to effective disaster risk reduction planning, disaster response, and long-term disaster recovery. Therefore, the process of dialogue can be as valuable to building local resilience capacities (e.g., communication skills and relationships building) as are the assessment results themselves (Arbon et al., 2016).

8.4 Limitations

While this research sought to solicit a diverse sample of perspectives across different stakeholder groups, data were collected based on the limited sample size and representativeness of workshop participants and neighbourhood-based focus groups. In the workshop with experts, out of the 13 participants, only one self-identified as a policymaker. In focus groups, several stakeholder types were not represented, including those who speak a language other than English, representatives from the business community, and other ethnic minority groups.

Results of this thesis were also limited by other sampling strategies and other biases, including:

- Participation of the research might be biased toward individuals who find the topic salient and relevant.

- Data collection methods could have created unintentional barriers for participation. These barriers include the timing, language accessibility, and location of focus groups. Further, the format of focus groups might not be conducive to data collection from certain segments of the population.

- In both the workshop and focus groups, participants' responses could have been biased by the opinions of other workshop attendees, by pre-existing relationships between participants, or by their perceptions of the facilitator (Frey & Fontana, 1991). One potential type of bias that existed in the research process is conforming, in which participants who had not yet formed an opinion were influenced by the opinion of others and reflected that influence in their comments (Carey, 1994). Another potential bias relates to censoring, whereby participants withheld their thoughts or contribution due to a lack of trust toward the facilitator or other group members (Carey, 1994). To minimise such biases, participants were asked to write out their responses individually to an initial set of questions before sharing their response with others. These written responses were analysed and coded.

- Environmental factors such as the location and size of focus groups could have impacted participants' interactions. Focus groups in this research were held in different settings, which were dictated by space availability and participants' preferences. As a result, one group was at a participant's house, while other groups were conducted in a more neutral setting such as in a community centre or a hired space located in the neighbourhood. Familiarity with a space and with other participants could have affected participants' comfort levels and inclination to share their opinions.

- The facilitator of group discussions can control the pace and direction of discussions and interrupt or stop conversations (Berg, 2004). Therefore, the way in which the researcher moderated discussions in the workshop and focus groups could have affected the depth in which a topic was discussed by participants.

Given limited sample size, sample representativeness, and potential biases, additional qualitative and quantitative research is needed to validate this thesis's proposed framework and measures.

8.5 Future research directions for assessing community disaster resilience

The development of social resilience measurement frameworks and social capital measures in this thesis exposed challenges that need to be addressed in future studies. These include developing culturally appropriate and relevant resilience assessment measures, identifying measures that reflect cross-scaled and cross-domain linkages, and developing dynamic assessment tools. These three points are discussed next.

8.5.1 Culturally responsive assessment and evaluation

As discussed previously, cultural and place-based influences play a significant role in shaping the perceptions of community disaster resilience. As communities are becoming more ethnically and culturally diverse, resilience assessments and interventions need to consider cultural and place-based influences. Understanding the cultural influences of diverse populations is integral to the validity and utility of assessment and evaluation results (Frierson, Hood, & Hughes, 2010).

One way that future studies on assessing disaster resilience can take cultural factors into account is to benchmark and evaluate neighbourhood-level disaster resilience with the culturally responsive evaluation (CRE) process. CRE is a holistic framework for centring evaluation within the context of culture (Frierson et al., 2010). Its central tenets are that no evaluations or evaluators are "culture-free" and that cultural values and beliefs are embedded in any evaluative effort (Frierson et al., 2010, p. 75; Hood, Hopson, & Kirkhart, 2015). Its approach takes into account how the needs and cultural values and beliefs of those being assessed are integrated into the assessment development process, with particular attention paid to the engagement of historically marginalised populations (Hood et al., 2015).

Cultural competencies[8] need to be emphasised and integrated into all phases of assessment, from planning, engaging stakeholders, framing and designing assessment measures, collecting and analysing data, and reporting results (City and County of San Francisco, 2016b; Herbst & Yannacci, 2013; Hood et al., 2015; IFRC, 2014; SRA International, 2008; Yarbrough, Shulha, Hopson, & Caruthers, 2011) (Figure 8.1). For example, under CRE, the engagement of outside researchers, government officials, and a diverse range of stakeholders is carried out to ensure that the framework and measures align with the context of each neighbourhood. Since data are given voice by those who collect, interpret, and disseminate them, understanding the cultural context and

[8] Cultural competence is defined as the ability – through having a set of congruent behaviours, attitudes, and policies within systems, agencies, and among professionals – to work effectively in cross-cultural situations (SRA International, 2008).

power relations embedded within each neighbourhood is imperative in the implementation phase of the assessment.

Figure 8.1 Cultural competence applied in the culturally responsive evaluation process. Reprinted from "Culturally responsive evaluation", by S. Hood, R. K. Hopson, and K. E. Kirkhart, 2015, *Handbook of Practical Program Evaluation*, p. 290.

CRE's culturally responsive philosophical and practical underpinnings could make a valuable contribution to baselining and assessing levels of resilience and progress that are reflective of local needs and priorities. Future studies should focus on how culturally appropriate strategies will be integrated in the validation and implementation of the proposed social resilience framework and measures presented in this research.

8.5.2 Cross-scale and cross-domain considerations

Many existing assessments lack the ability to assess the linkages between factors that contribute to vulnerabilities and resilience across various spatial scales (e.g., individual to city levels) and societal domains (e.g., physical, economic, and social) (Folke et al., 2003). Measuring resilience is a complex undertaking due to the difficulties in accounting for interdependencies within the same system and between systems.

At present, researchers who assess resilience holistically have recognised the limitations of existing assessment tools in evaluating the extent of interdependencies between resilience factors in contributing to disaster preparedness and disaster recovery. For instance, while Paton's (Paton & McClure, 2013) model of resilience is used to examine the interdependencies of psychological and social factors that facilitate individual disaster preparedness, researchers recognise that the strength

of linkages between the model's factors is dependent on social influences and cultural orientations (Paton, Sagala, et al., 2010). Additionally, Burton's (2014) study had limited success in identifying social, economic, infrastructure, institutional, environmental, and community capacity variables that could fully explain the speed of recovery of the built environment in the aftermath of Hurricane Katrina. Instead, he called for alternate approaches and standards that are "highly customizable and make use of primary source data" as a means to evaluate resilience (Burton, 2014, p. 84).

The qualitative approach of this thesis could provide a foundation for quantifying and qualifying potential cross-scale and cross-domain linkages. As illustrated in Table 7.6, Chapter 7, the proposed quantitative and qualitative measures of social capital go beyond the usual structural aspects of the concept to also examine underlying cognitive elements (e.g., perceived quality of relationships and networks) that could be used for baselining and tracking changes of social capital levels. Data collected from this type of assessment could provide further empirical support to resilience models such as the one developed by Paton and McClure (2013) (Figure 2.10, Chapter 2).

8.5.3 Static versus dynamic assessment approaches

Vulnerabilities and adaptive capacities of people and groups continually change. However, inherent to many quantitative (e.g., index) and qualitative (e.g., participatory assessment) methods of measuring resilience is that they capture a snapshot of vulnerabilities and resilience levels at a certain point in time (Gall, 2013; Villanueva, 2011). While this thesis identifies static social resilience assessment themes and measures that can be used to track temporal changes of resilience levels, the proposed themes and measures lack the ability to dynamically gauge the evolving process of learning and adaptation. Unfortunately, this problem is difficult to resolve due to the uncertainties surrounding hazard events and their consequences (Gall, 2013; Villanueva, 2011).

These uncertainties present significant challenges in assessing groups' activation and use of resources and capabilities to meet the unfolding demands of a hazard event. While loss modelling tools such as RiskScape (Appendix 5) can account for certain probable outcomes (e.g., economic and infrastructural losses) across a range of hazard scenarios, they are limited to specific societal dimensions that include the built infrastructure and economic conditions (Gall, 2013). Unfortunately, real-time analysis of resilience attributes and their interdependencies across societal systems has yet to materialise (Gall, 2013). As demonstrated in this thesis, social factors are integral to disaster preparedness, response, and recovery. Therefore, modelling key cognitive and structural processes and factors (e.g., social support, leadership capacities), as well as the interaction between them and with other factors in the built and economic environments, deserves additional research.

While this thesis assessment framework cannot account for how dynamic factors unfold in a natural hazard event, it provides a methodological process for assessing structural and cognitive conditions that facilitate the development and utilisation of adaptive skills, knowledge, and resources. The integration of lessons learned from past disasters, and people's perspectives on everyday stresses, can provide valuable insights on local adaptation processes and how relationships and knowledge are generated (Villanueva, 2011). Furthermore, advances in crowdsourcing and citizen participatory tools, such as volunteered geographic information or social media, could prove promising in assessing the dynamic resilience of groups and communities (Goodchild & Glennon, 2010; Houston et al., 2014; Orchiston et al., 2016; Paton & Irons, 2016).

Hence, the development of a dynamic assessment tool that incorporates and accounts for various contributing factors to social resilience is an important next step. According to practitioners and researchers interviewed by Villanueva (2011), there is a continued need for a dynamic monitoring and evaluation framework that can reflect the changing local contexts and concerns of stakeholders and provide real-time feedback to those involved in disaster management. Gall (2013) suggested a need for innovative approaches to dynamically identify uncertainties revolving around natural hazard events and assess the non-linear unfolding nature of resilience. The frontier of resilience assessment research may very well be identifying effective ways to use mobile tools to engage ordinary citizens (e.g., Soden, 2017) in assessing their communities' resilience, and integrating data collected from those tools with other types of qualitative and quantitative datasets.

Chapter 9 – Conclusion

Progress toward assessing neighbourhood-level disaster resilience requires an integrated approach around the development of assessment tools. Using this approach, this thesis examines how neighbourhood-based social resilience is framed and can be measured through the synthesis of the literature, expert opinions (i.e., hazards researchers, emergency management practitioners, and a policymaker), and perspectives of neighbourhood stakeholders. The integration of these perspectives is essential for advancing a model of shared responsibilities in disaster risk reduction (DRR), whereby each segment of the society has a distinct and complementary set of responsibilities for building disaster resilience (UNISDRb, 2015).

As the Sendai Framework for Disaster Risk Reduction stresses the importance of utilising a people-centred approach to reducing disaster risks, DRR practices need to be "multi-hazard and multisectoral, inclusive and accessible in order to be efficient and effective" (UNISDR, 2015b, p. 10). The framework calls for the public and private sectors, community-based organisations, and research institutions to work towards integrating disaster risk into their practices (UNISDR, 2015b). In line with this approach, this thesis offers a methodological roadmap for engaging multiple sectors that include academia and research institutions, the public sector, and civil society in the development of a social resilience assessment framework and a set of social capital measures that is reflective of neighbourhood needs and priorities. The participatory approach used in data collection results to research findings that reflect local dynamics and perspectives, which are at the heart of people-centred approach to DRR. While the private sector and certain community stakeholders (e.g., non-English speakers and youth) were not represented in this research process, their engagement in future studies could further strengthen the case for multisectoral and inclusive DRR planning, as well as highlight assessment perspectives not captured by this thesis.

As presented in Section 8.3.3, the framework for assessing neighbourhood-based social resilience includes 11 key areas – individual responsibility; community responsibility and planning; collective efficacy; cultural values and practices; diversity of skills; economic resources; education and training; understanding of potential hazard risks, impacts, and consequences; leadership and decision-making inclusiveness; sense of community and place attachment; and social networks – that are common across different perspectives. These shared characteristics across different stakeholder groups demonstrate the potential universality of social resilience assessment constructs at the neighbourhood level, and support existing models of community resilience such as Paton's resilience/adaptive capacity model (Figure 2.10). They also provide a foundation for local-level

stakeholders (e.g., policymakers, practitioners, and community members) who are looking into baselining neighbourhood disaster resilience using an integrated approach.

The proposed neighbourhood-based social resilience measurement framework (in Section 8.3.3) and social capital measures (in Chapter 7) highlight one important consideration in the development and implementation of resilience assessment tools at this geographic scale. While the results of this research point to a potential universality of assessment constructs and measures, caution is needed in mapping them directly onto neighbourhoods without consideration for contextual influences and characteristics. As participants in this research pointed out, social capital is influenced by neighbourhood-based demography, cultural influences on social support, and neighbourhood governance. The manifestation of these influences was found to be different in each of the study neighbourhoods. It is anticipated that different neighbourhoods will need to identify how these influences, as well as other neighbourhood-specific conditions and dynamics, affect their levels of social capital and other social resilience conditions. As such, research findings highlight the need to take contextual and place-based influences into consideration when assessing neighbourhood-level resilience. In addition to using general quantitative measures to evaluate various components of social resilience (e.g., social capital), open-ended qualitative questions are needed to unearth underlying neighbourhood-specific dynamics and conditions.

This thesis also presents an appreciative inquiry approach to examining the framing of community resilience that can help inform the development of DRR interventions that enhance and build upon neighbourhood social assets in meaningful ways. While taking a social vulnerability lens to DRR can address societal inequities that create individuals' and communities' vulnerabilities in the first place, most neighbourhood-based DRR interventions do not have scope and longevity (due to funding constraints) to alter broader societal conditions. Thus, using an appreciative inquiry approach allows local stakeholders to identify and prioritise community assets (and deficits) that are amendable to changes. Additionally, by identifying neighbourhood-specific resilience influences through this participatory action research, this thesis shifts some of the power from outside experts to local community actors in deriving essential resilience assessment factors that are important to them. This shift in power toward community stakeholders is critical to meet national and local policies in sharing DRR responsibilities. It also empowers these stakeholders, who are at the frontline in disaster preparedness, response, and recovery, to take ownership in disaster outcomes.

In sum, this integrative approach – both in terms of the engagement of different stakeholders and the use of both quantitative and qualitative measures – reduces obvious weaknesses that accompany a quantitative and top-down approach to assessing neighbourhood-level resilience.

While significant challenges remain that require future research – namely, adoption of culturally appropriate strategies in the validation of the thesis's proposed measurement framework and measures, consideration of cross-scaled and cross-domain linkages, and the development of a dynamic assessment tool – this thesis serves to create the necessary foundation for local stakeholders to become agents for change in building disaster resilience of their communities.

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Appendix 1 The Richter magnitude scale

Richter magnitudes	Description	Earthquake effects
< 2.0	Micro	Micro earthquakes, not felt.
2.0-2.9	Minor	Generally not felt, but recorded.
3.0-3.9		Often felt, but rarely causes damage.
4.0-4.9	Light	Noticeable shaking of indoor items, rattling noises. Significant damage unlikely.
5.0-5.9	Moderate	Can cause major damage to poorly constructed buildings over small regions. At most slight damage to well-designed buildings.
6.0-6.9	Strong	Can be destructive in areas up to about 160 kilometres (100 mi) across in populated areas.
7.0-7.9	Major	Can cause serious damage over larger areas.
8.0-8.9	Great	Can cause serious damage in areas several hundred miles across.
9.0-9.9		Devastating in areas several thousand miles across.
10.0+	Epic	Never recorded.

Note. From "What is the Richter magnitude scale?", by GNS Science, 2009 (https://www.gns.cri.nz/Home/Learning/Science-Topics/Earthquakes/Monitoring-Earthquakes/Other-earthquake-questions/What-is-the-Richter-Magnitude-Scale).

Appendix 2 The Modified Mercalli intensity scale (New Zealand version)

Category	Definition
MM 1: Imperceptible	Barely sensed only by a very few people.
MM 2: Scarcely felt	Felt only by a few people at rest in houses or on upper floors.
MM 3: Weak	Felt indoors as a light vibration. Hanging objects may swing slightly.
MM 4: Largely observed	Generally noticed indoors, but not outside, as a moderate vibration or jolt. Light sleepers may be awakened. Walls may creak, and glassware, crockery, doors or windows rattle.
MM 5: Strong	Generally felt outside and by almost everyone indoors. Most sleepers are awakened and a few people feel alarmed. Small objects are shifted or overturned, and pictures knock against the wall. Some glassware and crockery may break, and loosely secured doors may swing open and shut.
MM 6: Slightly damaging	Felt by all. People and animals are alarmed, and many run outside. Walking steadily is difficult. Furniture and appliances may move on smooth surfaces, and objects fall from walls and shelves. Glassware and crockery break. Slight non-structural damage to buildings may occur.
MM 7: Damaging	General alarm. People experience difficulty standing. Furniture and appliances are shifted. Substantial damage to fragile or unsecured objects. A few weak buildings are damaged.
MM 8: Heavily damaging	Alarm may approach panic. A few buildings are damaged and some weak buildings are destroyed.
MM 9: Destructive	Some buildings are damaged and many weak buildings are destroyed.
MM 10: Very destructive	Many buildings are damaged and most weak buildings are destroyed.
MM 11: Devastating	Most buildings are damaged and many buildings are destroyed.
MM 12: Completely devastating	All buildings are damaged and most buildings are destroyed.

Note. From "The Modified Mercalli intensity scale", by GNS Science, 2009 (https://www.gns.cri.nz/Home/Learning/Science-Topics/Earthquakes/Monitoring-Earthquakes/Other-earthquake-questions/What-is-the-difference-between-Magnitude-and-Intensity/The-Modified-Mercalli-Intensity-Scale).

Appendix 3 Abbreviated description of the levels of Modified Mercalli intensity scale (U.S. version)

Intensity	Shaking	Description/Damage
I	Not felt	Not felt except by a very few under especially favorable conditions.
II	Weak	Felt only by a few persons at rest, especially on upper floors of buildings.
III	Weak	Felt quite noticeably by persons indoors, especially on upper floors of buildings. Many people do not recognize it as an earthquake. Standing motor cars may rock slightly. Vibrations similar to the passing of a truck.
IV	Light	Felt indoors by many, outdoors by few during the day. At night, some awakened. Dishes, windows, doors disturbed; walls make cracking sound. Sensation like a heavy truck striking a building. Standing motor cars rocked noticeably.
V	Moderate	Felt by nearly everyone; many awakened. Some dishes, windows broken. Unstable objects overturned. Pendulum clocks may stop.
VI	Strong	Felt by all, many frightened. Some heavy furniture moved; a few instances of fallen plaster. Damage slight.
VII	Very strong	Damage is negligible in buildings of good design and construction; slight to moderate in well-built ordinary structures; considerable in poorly built or badly designed structures; some chimneys broken.
VIII	Severe	Damage is slight in specially designed structures; considerable in ordinary substantial buildings with partial collapse; great in poorly built structures. Fall of chimneys, factory stacks, columns, monuments, walls. Heavy furniture overturned.
IX	Violent	Damage is considerable in specially designed structures; well-designed frame structures thrown out of plumb. Damage is great in substantial buildings, with partial collapse. Buildings shifted off foundations.
X	Extreme	Some well-built wooden structures destroyed; most masonry and frame structures destroyed with foundations. Rails bent.
XI	Extreme	Few, if any (masonry) structures remain standing. Bridges destroyed. Rails bent greatly.
XII	Extreme	Damage total. Lines of sight and level are distorted. Objects thrown into the air.

Note. From "The Modified Mercalli intensity scale", by U.S. Geological Survey, n.d. (https://earthquake.usgs.gov/learn/topics/mercalli.php).

Appendix 4 Statement of contribution sheets for submitted journal papers

Chapter 5 – Paper 1

Kwok, A., Doyle, E. E. H., Becker, J., Johnston, D., & Paton, D. (2016). What is 'social resilience'? Perspectives of disaster researchers, emergency management practitioners, and policymakers in New Zealand. *International Journal of Disaster Risk Reduction*, *19*, 197–211.

Chapter 6 – Paper 2

Kwok, A. H., Paton, D., Becker, J., Hudson-Doyle, E. E., & Johnston, D. (2018). A bottom-up approach to developing a neighbourhood-based resilience measurement framework. *Disaster Prevention and Management: An International Journal*, *27*(2), 255–270.

Chapter 7 – Paper 3

Kwok, A. H., Becker, J., Paton, D., Hudson-Doyle, E. E. H., Johnston, D. (2018). Stakeholders' perspectives of social capital in informing the development of neighbourhood-based disaster resilience measurements. *Journal of Applied Social Science*. Submitted.

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STATEMENT OF CONTRIBUTION TO DOCTORAL THESIS CONTAINING PUBLICATIONS

(To appear at the end of each thesis chapter/section/appendix submitted as an article/paper or collected as an appendix at the end of the thesis)

We, the candidate and the candidate's Principal Supervisor, certify that all co-authors have consented to their work being included in the thesis and they have accepted the candidate's contribution as indicated below in the *Statement of Originality*.

Name of Candidate: Alan H Kwok

Name/Title of Principal Supervisor: David Johnston

Name of Published Research Output and full reference:

What is 'social resilience'? Perspectives of disaster researchers, emergency management practitioners, and policymakers in New Zealand

Kwok, A., Doyle, E. E. H., Becker, J., Johnston, D., & Paton, D. (2016). What is 'social resilience'? Perspectives of disaster researchers, emergency management practitioners, and policymakers in New Zealand. International Journal of Disaster Risk Reduction, 19, 19 – 211.

In which Chapter is the Published Work: Chapter 5

Please indicate either:

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  and / or
- Describe the contribution that the candidate has made to the Published Work:

Candidate's Signature

5 July 2018
Date

Principal Supervisor's signature

5 July 2018
Date

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Name of Candidate: Alan H Kwok

Name/Title of Principal Supervisor: David Johnston

Name of Published Research Output and full reference:
A bottom-up approach to developing a neighbourhood-based resilience measurement framework

Kwok, A. H., Paton, D., Becker, J., Hudson-Doyle, E. E., & Johnston, D. (2018). A bottom-up approach to developing a neighbourhood-based resilience measurement framework. Disaster Prevention and Management: An International Journal, 27(2), 255 – 270.

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STATEMENT OF CONTRIBUTION TO DOCTORAL THESIS CONTAINING PUBLICATIONS

(To appear at the end of each thesis chapter/section/appendix submitted as an article/paper or collected as an appendix at the end of the thesis)

We, the candidate and the candidate's Principal Supervisor, certify that all co-authors have consented to their work being included in the thesis and they have accepted the candidate's contribution as indicated below in the *Statement of Originality*.

Name of Candidate: Alan H Kwok

Name/Title of Principal Supervisor: David Johnston

Name of Published Research Output and full reference:
Stakeholders' perspectives of social capital in informing the development of neighbourhood-based disaster resilience measurements

In which Chapter is the Published Work: Chapter 7

Please indicate either:

- The percentage of the Published Work that was contributed by the candidate: 97%
  and / or
- Describe the contribution that the candidate has made to the Published Work:

Candidate's Signature

5 July 2018
Date

Principal Supervisor's signature

5 July 2018
Date

Appendix 5 Integrating social vulnerability indicators in RiskScape's earthquake risk modelling

Integrating Social Vulnerability Indicators in RiskScape's Earthquake Risk Modelling

A. H. Kwok

GNS Science Report 2016/09

March 2016

BIBLIOGRAPHIC REFERENCE

Kwok, A. 2016. Integrating Social Vulnerability Indicators in RiskScape's Earthquake Risk Modelling, *GNS Science Report* 2016/09.

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ADDENDUM

Abstract

This report discusses the feasibility of integrating social vulnerability indicators in RiskScape's earthquake risk models. It evaluates key social vulnerability variables that are being used in vulnerability assessments and risk modelling. It also discusses the relationship between social vulnerability factors and earthquake losses. Results of the report have identified opportunities and challenges in using social vulnerability variables as fragility functions, and suggest further analysis between social vulnerability variables and modelled earthquake losses in RiskScape. Additionally, mapping social vulnerability onto model outputs might be more useful for end users in pre-disaster decision-making processes. Potential social vulnerability indicators to be incorporated in RiskScape are presented.

Keywords

Social vulnerability; indicators; vulnerability index; risk modelling; RiskScape; earthquake loss

1.0 Introduction

1.1 Background

Risk modelling has been used extensively in the insurance and risk management industries to aid in making cost-benefits and more informed risk management decisions (Grossi & Kunreuther, 2005; Pondard & Daly, 2011). In New Zealand, RiskScape – a joint project of NIWA and GNS Science – was developed in the mid-2000s with the goal of improving community resilience to natural hazards by supporting planning and response activities of government, councils, and utility/infrastructure operators (Bell & King, 2009). By converting hazard exposure information into likely consequences for the region, this decision-support tool provides decision-makers with quantitative information on direct and indirect socio-economic losses and casualties across a range of natural hazards (Bell et al., 2007; Bell & King, 2009).

In RiskScape, the model characterises the hazard based on the hazard type (e.g., earthquake, tsunami, flood), exposure (e.g., flood inundation depth, earthquake shaking magnitude), and probability (expressed as recurrence interval or annual exceedance probability). It characterises inventory based on both physical and human assets (e.g., physical infrastructure), their attributes (e.g., construction type and age of buildings) and values (e.g., number of people living on a property). Figure 1.1 illustrates the structure of the RiskScape system. The integration of hazard and asset modules enables the quantitative calculation of vulnerability of structures and people, in which the loss to the inventory (asset) is measured. The RiskScape model evaluates the direct and indirect socio-economic losses that include the following (National Institue of Water & Atmospheric Research, 2015b):

- Human losses (injuries and casualties);
- Human displacement;
- Human susceptibility to injuries;
- Damage state of physical structures;
- Reinstatement cost (direct costs caused by exposure of the asset to the hazard); and
- Functional downtime (productive time lost due to the impact of the hazard on the asset).

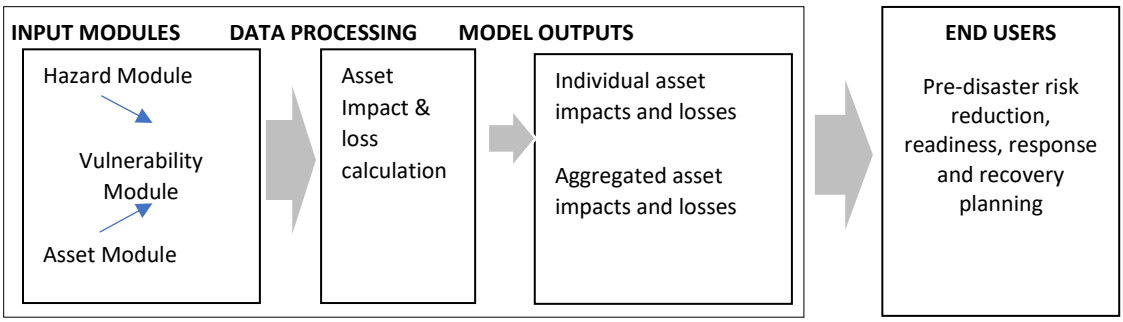

Figure 1.1. Vulnerability exposure and resilience dataset overlay in RiskScape risk modelling. Retrieved from https://wiki.riskscape.org.nz/index.php/RiskScape_Model.

More recently, risk models begin to take into account the social vulnerability factors that cottribute to direct and indirect socio-economic losses from natural hazards such as earthquakes (e.g., Carreño

et al., 2007; Noriega & Ludwig, 2012; Schmidtlein et al., 2011; Walker et al., 2014). This report seeks to examine the feasibility of incorporating social vulnerability factors in the RiskScape risk modelling software.

1.2 Research questions

This report seeks to answer the following primary research question:

- How can social vulnerability indicators be incorporated into RiskScape's earthquake loss modelling?

In order to answer the primary question, the following component questions will be addressed:

- What existing indicators are currently used to measure social vulnerability?
- What social vulnerability factors are associated with earthquake hazard outcomes?
- What social vulnerability indicators are appropriate for use within the New Zealand context?

2.0 Literature review

2.1 Vulnerability as a concept

The concept of vulnerability evolved from social sciences in the late 1970s and early 1980s in response to the predominant focus of disaster risk on physical hazards (Birkmann, 2006a). An early exploration of the concept of disaster vulnerability was the publication of 'Taking the naturalness out of natural disasters' by O'Keefe et al. (1976), in which the authors argued that the increasing frequency of disasters is a consequence of growing vulnerability of people, especially those living in developing countries. The root causes of differential vulnerability, the authors observed, stem from socio-economic conditions related to the marginalisation of people and underdevelopment of communities. With the publication of *Interpretations of Calamity from the Viewpoint of Human Ecology* by Hewitt (1983), the focus of vulnerability analysis has shifted from physical hazard agents to social processes. Since then, the conceptualisation of the vulnerability has been undertaken by other disaster researchers from different academic perspectives. Drawing from the perspectives of political ecology and community development, anthropologist Oliver-Smith (2004) and geographers Blaikie, Wisner (Blaikie et al., 1994), Cutter (1996), and Bolin (2006) have conceptualised people's vulnerability to natural hazards as being shaped by political, environmental and socioeconomic forces and unsustainable development. Additionally, sociologist Zakour (2010), health psychologist Norris (Norris et al., 2008), as well as Cutter (1996) and Bolin (2006) have focused on the equity of social conditions that affect people's vulnerability to disaster. These researchers argue that the level of vulnerability is determined by the intersection of hazards with societal conditions that are created by a community's sociocultural characteristics; accessibility, availability and distribution of resources; and demographic attributes. There exist temporal and spatial differences among these conditions in a community, so that the more equitable the social conditions and the access to and allocation of resources in a community, the less vulnerable and more resilient it becomes (Zakour & Gillespie, 2013c).

Although hazards researchers have been conceptualising societal vulnerabilities to environmental hazards over the past few decades, no consensus has been reached regarding how the concept is defined and measured (Birkmann et al., 2013; Cutter, 1996). In Figure 2.1, Birkmann (2006b) traced the progression on the expanding scope of the vulnerability concept. At the very basic level, vulnerability encompasses the conditions and characteristics of people, societal systems and processes that are exposed to risks (internal risk factors). Building upon this basic understanding, the concept of vulnerability widens to capture how these vulnerable conditions contribute to deaths, injuries, and losses from natural hazard events (human centred) by drawing on the capacities (e.g. coping and adaptive capacities) of communities to mitigate hazard risks, reduce vulnerabilities, respond to and cope with the impact of the hazard event (levels 3 and 4 of the Figure 2.1). The intersection of vulnerabilities and capacities of systems and processes reside in various societal domains (level 5), such as communities and social groups, physical infrastructure, ecosystem, and economic system (Birkmann, 2006b).

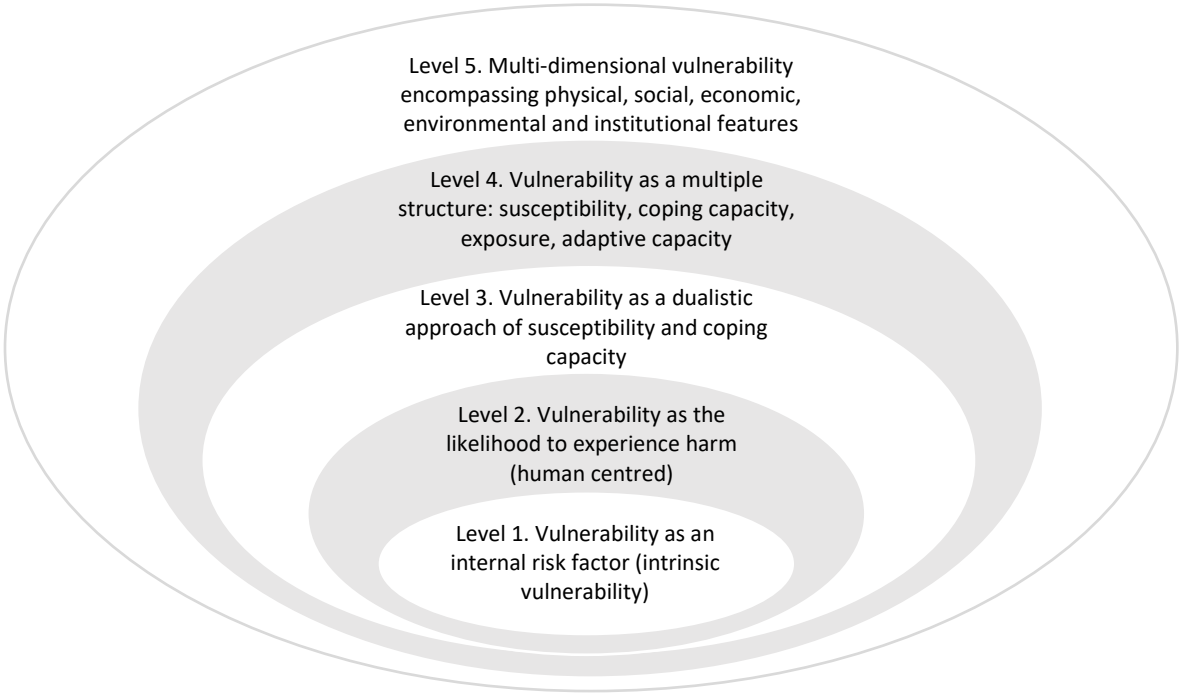

Figure 2.1. Expanding scope of the vulnerability concept. Adapted from "Measuring vulnerability to promote disaster-resilient societies: Conceptual frameworks and definitions", by J. Birkmann, 2006, *Measuring vulnerability to natural hazards: Towards disaster resilient societies, 1*, p. 17.

2.2 Vulnerability frameworks

Because of the multi-dimensionality of vulnerability, numerous frameworks have been proposed to explore the various static and dynamic drivers of societal vulnerabilities that influence the susceptibility of people and communities to natural hazards. Researchers have developed a number of typologies of vulnerability that reflect various theoretical and methodological approaches (e.g., political economy, social-ecology, physical science, climate change science, and spatial analysis) and spatial and temporal scales at which vulnerable conditions exist. For the purpose of this report, a brief overview of select vulnerability frameworks that address the social conditions of societies are presented in the following section, many of which are rooted in political economy and social-ecological perspectives (Eakin & Luers, 2006).

2.2.1 Hazards of place model

The hazards of place model reflects an early attempt to holistically assess and integrate the multi-faceted societal vulnerabilities with the exposure of hazards of places (Cutter, 1996). This model captures the various elements and conceptual thinking of vulnerability, which includes biophysical risks, pre-existing conditions and characteristics of societal domains (e.g., social vulnerability), and societal responses that influence vulnerability of places. The hazards of place model has contributed to the development of the well-established Social Vulnerability Indicators (SoVI) (see Addendum A3.24).

2.2.2 Pressure and Release model and the Access model

Based on the political economy approach to vulnerability assessment, the Pressure and Release (PAR) model links societal vulnerability to the processes that generate vulnerability and the hazard event (Wisner et al., 2004). It theorises that vulnerability arises from the embedded unequal

distribution of and access to power and resources, and such inequality results in structural constraints that lead to unsafe conditions (Birkmann, 2006b). Inequality manifests itself in the social, economic, and political environments and creates 'pressures' on a society such as disparity in the provision of health services inequality and the lack of building codes that result in societal vulnerability (e.g., malnutrition and unsafe housing) (Zakour & Gillespie, 2013b).

Complementing the static PAR model is the Access model, which accounts for the interaction between the structural aspects of the hazard and the dynamic components of a society that unfold throughout the disaster sequence. The Access model describes the "amount of 'access' that people have to the capabilities, assets and livelihood opportunities that will enable them (or not) to reduce their vulnerability and avoid disaster" (Wisner et al., 2004, pg. 79-80). The Access model illustrates how differential access to assets and resources before and after a hazard event contributes to unsafe conditions (part of the PAR model) and the divergent processes that affect people's reaction and adaptation to that particular hazard event (Wisner et al., 2004). These processes include the choices people make, prior to a disaster, that shape their pre-existing vulnerabilities, the availability of and people's capacity to access different types of resources (e.g., material and non-material capitals), and the types of vulnerability and risk reduction strategies and interventions taken before and after a disaster (Wisner et al., 2004). How people cope with and adapt to a hazard event would influence subsequent livelihood choices, processes, and capacity that impact responses and vulnerability to future hazards (see Wisner et al., 2004, chapter 3).

2.2.3 Driver-Pressure-State-Impact-Response model

The Driver-Pressure-State-Impact-Response model addresses the relationships between societal conditions, actions, and impacts in sustainable development (Bowen & Riley, 2003). It seeks to address the underlying causes and societal conditions (*drivers*) within different domains (i.e., social, economic, institutional, and natural systems) that result in actions (*pressures*) that affect environmental and other societal changes (*state* and *impacts*). It also measures how society (e.g. institutions) respond (*response*) to such changes. Bowen and Riley (2003) based their socioeconomic indicators on this model (see Addendum A3.6), and these indicators reflect the cause and effect linkages of process, actions and outcomes.

2.2.4 The MOVE framework

Based on the theoretical perspectives (i.e., disaster cycle, risk and vulnerability, and social-ecology) that underlie disaster risk management (DRM) and climate change adaptation (CCA), the MOVE framework bridges risk and vulnerability and integrates the concept of adaptation and resilience. The MOVE framework reflects the need to capture the multi-dimensionality of vulnerability, as it accounts for causal factors such as exposure, susceptibility, lack of societal response capacities (Birkmann et al., 2013). It also encompasses the different societal domains of vulnerability that include physical, social, ecological, economic, cultural, and institutional systems, and integrates adaptive capacities and actions (Birkmann et al., 2013). Similar to the Access model (Wisner et al., 2004) and the hazards of place model (Cutter, 1996), the MOVE framework incorporates a feedback loop between these elements, demonstrating that learning and adaptation influence exposure, susceptibility and response capacity of a society to future hazards. Respective vulnerability indicators based on this framework is listed in Addendum A3.12).

2.2.5 Sustainable Livelihoods framework – Capitals and capacities

The concept of sustainable livelihoods has its root in the development field. It is a conceptual framework that underpins the development approach to reduce poverty, improve livelihoods, and sustain the resources that are vital to different livelihood strategies (Scoones, 1998). It is commonly used to assess available individual and household assets or capital to support livelihoods and to cope with a hazard event (International Federation of Red Cross and Red Crescent Societies, 2007). The framework involves the analyses of five key elements: context (societal conditions), livelihood resources (capitals), institutional processes, livelihood strategies, and sustainable livelihood outcomes (Scoones, 1998). As such, vulnerability assessments based on the sustainable livelihood framework focus on livelihood assets (i.e., capitals) and capacities, as well as contextual factors (e.g., wider policies), that affect people's living conditions. This framework has been linked to the reduction of social vulnerability of the poor to disasters (Cannon et al., 2003). Many existing vulnerability measurements integrate various attributes of this perspective.

Underlying all of these frameworks is the assumption that people's vulnerability to natural hazards is a socially constructed phenomenon that's rooted and shaped in the "historical, cultural, social, and economic processes that impinge on the individual's or society's ability to cope with disasters and adequately respond to them" (Cutter, 1996, p. 533).

2.3 What is social vulnerability?

One of the vulnerability domains relates to the 'social' dimension of societies. All of the previously discussed vulnerability frameworks capture certain aspects of this dimension. Social vulnerability – the social dimension of vulnerability – is generally defined as the "likelihood that an individual or group will be exposed to and adversely affected by a hazard" and is related to the potential for losses (Cutter 1996, p. 532). Based on past vulnerability discourse and research, Downing et al. (2005, p. 3) encapsulated six attributes of social vulnerability thinking:

- Vulnerability is the differential exposure to stresses experienced or anticipated by different exposure units.
- Vulnerability is a dynamic process, changing on a variety of inter-linked time scales.
- Social vulnerability is rooted in the actions and multiple attributes of human actors.
- Social networks drive and bound vulnerability in the social, economic, political and environmental interactions.
- Vulnerability is constructed simultaneously on more than one scale.
- Multiple stresses are inherent in integrating vulnerability of peoples, places and systems.

Social vulnerability involves more than the likelihood of people being injured or killed from a hazard event, and includes the contextual factors that influence differential levels of preparedness, resilience, and capacities to anticipate, respond, and recover from it (Cannon et al., 2003). According to Cannon et al. (2003, p. 5), social vulnerability is the complex set of characteristics that include a person's:

- initial well-being (nutritional status, physical and mental health, morale);
- livelihood and resilience (asset pattern and capitals, income and exchange options, qualifications);
- self-protection (the degree of protection affected by capability and willingness to build safe homes, use of secure sites);

- social protection (forms of hazard preparedness provided by society including building codes, mitigation measures, shelters, and preparedness); and
- social and political networks and institutions (social capital, but also includes the role of institutional environment in setting conditions that facilitate hazard precautions, peoples' rights to express needs, and of access to preparedness).

Drawing from these characteristics, social vulnerability is more broadly defined than the traditional aspects of vulnerability such as gender, age and income distribution, and it also relates to socially constructed economic and physical attributes and features that either enable or impede the ability of individuals and communities to anticipate, respond to, and recover from a hazard event (Birkmann, 2006a). Because social vulnerability is intricately linked to other societal functions and processes, measurements of social vulnerability "should not be limited to an estimation of the direct impacts of a hazardous event," but it should "be seen as the estimation of the wider environment and social circumstances" (Birkmann, 2006a, p. 14).

2.4 Social vulnerability indicators

Since social vulnerability comprises of various aspects of societal characteristics, there is a wide range of indicators that assess a society's social vulnerability to natural hazards. A review of 29 indices, tools, and checklists relating to social vulnerability has been conducted for this report. The goal of this review is to identify key indicators that are used in assessing social vulnerability. By adapting the Cutter's (2015) typologies on resilience assessments, each of the vulnerability assessment's type, spatial/study unit, focus, domain, method, application area, and main concepts measured are categorised (Addendum A2.0).

The three approaches to vulnerability assessments are indices, checklists, and tools. Indicators are the most widely used in assessing societal vulnerabilities to natural hazards. They are quantifiable variables that represent certain characteristics of vulnerability (Cutter, 2016). The aggregation of indicators creates an index. The use of an index is beneficial because it "condense[s] a wide range of information on different (but related) phenomena into a single measure" (von Schirnding, 2002, p. 22). The checklist is another approach to assessing vulnerability, which "provides an evaluation of performance or progress toward a goal" by assessing the presence or absence of vulnerability-related items or actions (Cutter, 2015, p. 5). The third category of vulnerability assessments is tools, which include mathematical models, specific procedures, or guidance that enable stakeholders to understand the relationships of various vulnerability characteristics.

These assessments can also be categorised by their methodological approaches. Bottom-up vulnerability assessments use "locally generated" data sources for application to that particular place (Cutter, 2015, p. 5). These assessments can be both qualitative (e.g., interviews) and quantitative (e.g., ranking by local stakeholders). Top-down assessments, in comparison, "strive toward comparisons across varying units of analysis" by using broad-scale data sources, such as those from state, national, or international datasets (Cutter, 2015, p. 5).

The assessments are also categorised based on the type(s) of natural hazard and related vulnerabilities that they seek to evaluate. Some assessments examine vulnerabilities associated with climate-related hazards (e.g., floods, cyclones, droughts), while others are measured against geological hazards (e.g., earthquakes). A few assessments are developed for all hazard types.

The unit of analysis for each vulnerability assessment can be fine-scale (e.g., community) or broad-scale (national or international). Some of the assessments have been tested and applied in certain

geographic areas or regions, while others assess vulnerability that is national or international in scope.

The domain for each assessment refers to the societal characteristics or capacities. Characteristics are quantifiable aspects that are inherent in individuals or communities. Whereas capacities are evaluations of performance or quality that are embedded within a society (Cutter, 2016). Capacities might include less tangible societal components such as leadership, quality of the emergency planning process, and individual cognitive components such as values and beliefs.

Of the 29 vulnerability assessments reviewed, the concepts being measured are listed in Table 2.4. These concepts can be categorised into different societal domains – built, economic, social, institutional, and natural environments. However, many of these concepts are interrelated, and based on how social vulnerability is framed, some of the concepts cross between different societal domains. Each vulnerability concept is accompanied by measurement variables. In Addendum A3.0, vulnerability concepts and associated variables are presented for each of the 29 vulnerability indices, checklists and tools

Table 2.4. *Main concepts measured by vulnerability indices, tools, and checklists*

Built environment	**Economic environment**
Location of community	Economic stability and wellbeing
Physical description of community	Economic activities
Infrastructure and access	Dependence on agriculture
Technology/technical capacity	Livelihood
Physical vulnerability	Unemployment
Development pressure/capital construction	Income deprivation/poverty
Exposure and susceptibility	Natural resource dependence
	Living standards
Social environment	**Institutional environment**
Health (including health services, sanitation, food and water, nutrition, and disabilities)	Governance
Safety	Politics
Community	Development
Social connections/networks/cohesion	Early warning capacities
Conflict/social capital	Institutional stability and strength of public infrastructure
Civic participation	Organisational/institutional
Knowledge and skills	Global interconnectivity
Education	Policy indicators
Cultural traditions	**Natural environment**
Human uses/activities	Climactic conditions
Housing and transportation	Ecology and ecosystems
Population dynamics (including migration, rurality)	Quality of the environment
Exposed people	Habitat change/ecological value
Lack of resilience	Contaminant introduction
Capacity to cope	Resource extraction activities
Demographics (including age and longevity, gender, household composition, dependent population, minority status/language)	Environmental health

Social vulnerability indicators in vulnerability assessments are selected based on their theoretical underpinnings, the types of hazards, and societal contexts. As such, indicators that are based on the sustainable livelihood framework focus more on the social, economic, and natural assets and

resources of households and communities, whereas indicators based on the pressure and release framework tend to evaluate societal characteristics that create unsafe conditions for people. Social vulnerability is also measured at different temporal scales, such as indicators that are based on the drive-pressure-state-impact-response framework (Bowen & Riley, 2003). Moreover, social vulnerability indicators are also tailored to local conditions or specific hazards. For example, governance indicators such as voice and accountability and civil liberties have been determined to be associated with human losses from climate-related disasters in Brooks et al.'s analysis (2005); indicators of minority status are integral to the Social Vulnerability Index (SoVI); and an indicator of HIV/AIDS status is used in the Index of Social Vulnerability to Climate Change for Africa (Vincent, 2004).

Across the board, social vulnerability indicators seek to address social characteristics and conditions that leave people and communities more susceptible to the consequences of natural hazards and impede their efforts to effectively respond to and recover from hazard impacts.

2.5 Determinants of social vulnerability to earthquakes

According to Wisner et al. (2004, p. 239), people's *ex ante* and *ex post* vulnerability to earthquakes involves the space- and time-related characteristics of the earthquake and the socio-economic characteristics of the population at risk. Furthermore, as discussed previously, people's vulnerabilities are also influenced by their environment. The intersection of these characteristics determines who will be affected and how they will be impacted by an earthquake. In the next few sections, factors that affect people's vulnerability to earthquakes will be discussed.

2.5.1 Epidemiological model for earthquake mortality and morbidity

Death and injury during and after earthquakes depend on a variety of factors, including physical factors associated with the earthquake itself, architectural variables that govern the type and strength of built infrastructures, and social variables that influence exposure to risk of injury or death (Alexander, 1996). The factors that influence earthquake health outcomes can be framed using the epidemiology triangle, which is comprised of three interrelated aspects: seismic and geologic, human and individuals, and the built environment (Figure 2.5.1) (Ramirez & Peek-Asa, 2005). Seismic and geologic factors are associated with an earthquake's magnitude, shaking intensity, and epicentral distance, as well as the geology of the local terrain. The human and individuals characteristics refer to social and behavioural variables, including patterns of human activity, demographics, behaviours, and institutional support such as the effectiveness of search and rescue operations. The built infrastructure corresponds to the built environment characteristics, which consist of factors relating to the building type, construction materials, maintenance of buildings, age and height of buildings, as well as associated building codes that govern the susceptibility of collapse during and after an earthquake event (Alexander, 1996; Ramirez & Peek-Asa, 2005).

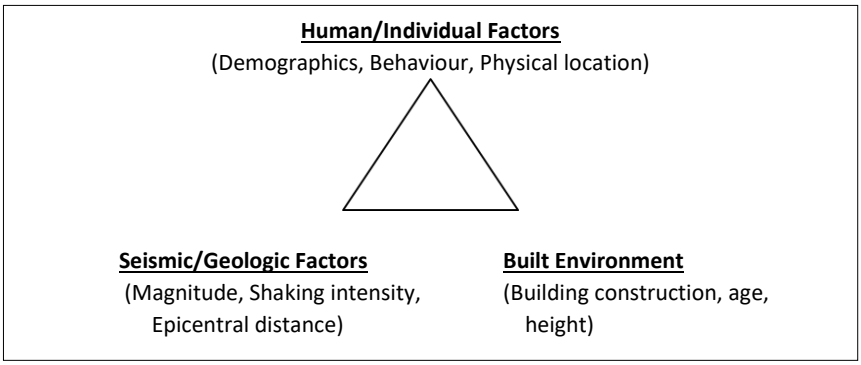

Figure 2.5.1. Earthquakes and the classic epidemiological model. Adapted from "Epidemiology of traumatic injuries from earthquakes" by M. Ramirez and C. Peek-Asa, 2005, *Epidemiologic reviews, 27*, p. 49.

These three types of factors, to a varying degree, influence human casualties and injuries. A large number of studies have focused on the seismic and geologic factors and the built environment characteristics related to earthquake impacts, in part because these variables produce consistent earthquake loss outcomes in most earthquake events (Doocy, Daniels, Packer, Dick, & Kirsch, 2013; Peek-Asa, Ramirez, Seligson, & Shoaf, 2003). For instance, the majority of earthquake casualties are caused by structural collapses (Alexander, 1996; Coburn, Spence, & Pomonis, 1992; Cousins, Spence, & So, 2008), and different building types have been associated with differential injury and mortality rates (Angus et al., 1997).

2.5.2 Social vulnerability and earthquake losses: Mortality and morbidity

A review on epidemiological articles (see Appendix A1.0) examining associations between social vulnerability factors and earthquake deaths, injuries, and displacement was conducted as part of this report. Studies on earthquake epidemiology predominately analyse the differential earthquake impacts on age and sex. Additional variables being examined include disability, socioeconomic status, relationship status and residential status.

A brief summary of the literature on the differential impacts based on age, gender, and socioeconomic status is presented next.

In a global analysis of epidemiological articles covering mortality of earthquake events 1980 and 2012, Doocy et al. (2013) reported that 45% (n=6649) of deaths were males and 55% (n=8060) of deaths were females, yielding a ratio of 1.0 to 1:12 for male to female mortality. In terms of earthquake injuries, Alexander (2012) and Ramirez & Peek-Asa (2005) found inconsistent associations between injury and demographic variables. The relationship between demographic factors such as age and sex and the risk of injuries is complex (Shoaf et al., 1998). According to Shoaf et al. (1998), both of these characteristics are indicative of other risk factors associated with age and sex. For example, in the 1995 Kobe earthquake, older adults were disproportionately impacted by the earthquake not because of vulnerability attributed to age, but because older people live in areas that are more exposed to risk of injuries and deaths (Shoaf et al., 1998; Tanida, 1996). In Japan, older adults tend to live on the ground floor of dwellings for accessibility concerns, while younger family members live on the upper floor. During the earthquake, the collapse of two storey structures contributed to a higher rate of injuries and deaths for the elderly. Moreover, compared to their younger counterparts, older adults may be less likely to attempt risky behaviours that are associated with injuries in an earthquake, such as running or trying to catch falling objects (Shoaf et al., 1998).

Socioeconomic status (SES) was associated with earthquake injuries and deaths for a number of events, such as the Chi Chi earthquake in Taiwan, the 2007 Peru earthquake, and the 2005 northern Pakistan earthquake (Chou et al., 2004; Milch et al., 2010; Sami et al., 2009). SES was correlated to higher injury and mortality rates due to a higher percentage of low-income residents living in weaker constructed dwellings that are located in rural areas and areas at the peripheral of urban centres. However, this relationship is not consistent across all earthquake events, especially those that had occurred in developed countries, where building codes are more consistently applied.

Based on the epidemiological studies reviewed, the findings reveal that:

- Earthquake mortality is associated with structural collapses.
- Correlations between social vulnerability variables and human losses are tenuous due to inconsistent outcomes from earthquake events in developing and developed countries. The immediacy of search and rescue and access to health care services also influences death and injury rates.
- Social contributors to behaviours may increase risk of injuries (e.g., mothers running to protect their kids).
- Confounding variables may influence human losses.
- Location (e.g., mortality clusters: schools, apartment complexes) and underlying determinants (e.g., age, socioeconomic status) have different impacts on death and injury rates.

Health outcomes from earthquake events, therefore, are influenced by the intersection of disparate factors (e.g., seismic characteristics, the built environment and social factors). As illustrated in the literature review, earthquake impacts on human losses need to be contextualised locally.

3.0 Where to go from here?

3.1 Social vulnerability assessments in New Zealand

Social vulnerability assessments and surveys have been developed for New Zealand. Although these assessments are not hazard-dependent, they provide a broad overview of the current thinking and trends in how social vulnerability is measured.

3.1.1 New Zealand Deprivation Index

The New Zealand Deprivation Index (NZDep Index) was developed in the mid-1990s by the Health Services Research Centre at Victoria University of Wellington, to address the requirements of government and social agencies for a standardised measure of socioeconomic deprivation status in a small area (Crampton, Salmond, & Sutton, 1997). Over the years, the index, which comprises of 10 socioeconomic variables, has been updated to include new census data. It is used by government and research institutions for resource allocation of government services (e.g., health care and social services), research (e.g., investigations on the links between deprivation and health outcomes), and advocacy by community groups and community-based service providers (Atkinson et al., 2014). Measures of socioeconomic deprivation have been developed and used by health researchers to understand the association between the levels of deprivation and a variety of health outcomes. In New Zealand, the index has been used to research mortality rates and prevalence of illness and health behaviours (see Salmond & Crampton, 2000 for a review of NZ studies). The NZDep Index has also been used as a proxy for socio-economic vulnerabilities to hazards in New Zealand (e.g., Khan, 2012; Paton, Johnston, & Saunders, 2006; Taranaki Regional Council, 2012).

A full list of variables included in the NZDep Index can be found in Addendum A3.14.

3.1.2 New Zealand Index of Neighbourhood Social Fragmentation

With extensive studies examining the association between social cohesion and capital (e.g., social networks) of people and communities and health outcomes from both hazard and non-hazard events (e.g., Aldrich & Meyer, 2014; Giordano et al., 2012; Lochner, Kawachi, Brennan, & Buka, 2003; Szreter & Woolcock, 2004), social fragmentation of communities adds a different dimension to social vulnerability, and is a topic of interest for researchers seeking to understand its potential relationship to health status, including injury rates, heart disease, and mental health conditions (see Ivory et al., 2012). Using New Zealand census data, Ivory et al. (2012) developed a small area measure of neighbourhood social fragmentation index using variables that are based on three related conceptual dimensions, including (1) shared norms and values, (2) place attachment, and (3) social resources. Scores on the index are significantly associated with individual perceptions of neighbourhood cohesion, with higher levels of social fragmentation correlating to lower perceptions of neighbourhood cohesion.

A full list of NeighFrag variables can be found in Addendum A3.15.

3.1.3 Resilience Index New Zealand

The Resilience Index New Zealand (RINZ) measures community levels of resilience, which are framed as positive health outcomes (Pearson, Pearce, & Kingham, 2013). The index measures the built, physical, and social domains of neighbourhood characteristics. Within the social domain, many of the variables used to measure the resilience of the social environment have been used to measure

social vulnerability to hazards (see Addendum A3.18). The social variables of the Resilience Index New Zealand include culture, community participation, rurality, and cohesion.

Unlike the NZDep and NeighFrag indices, which have been used to draw the relationship between high socioeconomic deprived areas and low health status, the Resiience Index New Zealand highlights that not all socioeconomic deprived communities experience poorer health outcomes (i.e., higher rates mortality, morbidity, and chronic disease) (see literature review by Pickett & Pearl, 2001). In particularly, the study found that the social characteristics of resilient neighbourhoods include main urban areas, higher social fragmentation, more new and incoming residents, and lower access to *marae*. Some of these 'resilient' characteristics, such as the influx of new residents and high population density (in urban areas), are consistent with past research findings that demonstrate the relationships between these variables and positive health outcomes. However, other resilient characteristics, such as high social fragmentation and lower access to *marae*, point to the need for further examination of mediating factors that affect localised levels of resilience.

3.1.4 Other New Zealand assessments relating to social vulnerability

In addition to the indices described above, the New Zealand government also conducts a variety of assessments relating to social vulnerability and hazards (see Table 3.1.4). Unlike the indices that are based on census datasets, these assessments include both quantitative and qualitative datasets captured from self-reported surveys.

Table 3.1.4. *New Zealand assessments relating to social vulnerability*

Name/Date Range	Description	Scale of Analysis	Source
Quality of Life Survey (2003, 2004-2014)	Measures the perceptions of over 5,000 residents living in six of the country's urban areas in eight areas: quality of life; health and well-being; crime and safety; community, culture and social networks; council processes; built environment; transport; economic well-being.	Regional	Nielson, 2014
New Zealand General Social Survey (2008-) ongoing	Measures the well-being of New Zealanders aged 15 years and over. The survey covers a wide range of social and economic measures in areas including quality of life, health and financial well-being, sense of purpose, cultural and social networks, housing, safety and security, and trust. The 2016 survey will also include items on civic and cultural participation)	National	Statistics New Zealand, 2014b
New Zealand Health Survey (2011-) ongoing	Provides information about the health and wellbeing of New Zealanders using 48 key indicators on health behaviours, health status, and access to health care for adults and children.	National	Ministry of Health, 2014
Get Ready Get Thru Campaign Survey (2006-2014)	Measures New Zealand residents' disaster preparedness and assesses the effectiveness of the campaign over time.	National	Ministry of Civil Defence and Emergency Management, 2014
Disability Survey (1996, 2001, 2006, 2013)	Measures the prevalence of disability across population subgroups and the disability rates for different types of impairment (e.g., physical, sensory, intellectual, psychological/psychiatric). The survey is self-reported or reported by the primary caregiver.	National	Statistics New Zealand, 2014a

Survey of Family, Income and Employment (SoFIE) (2002-2009)	Details annual information on income such as employment and education experiences, household and family status and changes, demographic factors and health status, from over 18,000 individuals.	National	Statistics New Zealand, 2015b

3.2 Social vulnerability indicators for earthquake risk modelling

With an increasing need by hazards researchers and practitioners to understand who is (and will be) at risk, risk modelling can bridge the knowledge gaps. This section describes attempts by researchers and practitioners alike in using social vulnerability indicators in modelling earthquake risks.

3.2.1 The Urban Risk Evaluation

The urban risk evaluation uses an aggregation of indices to describe seismic risks (Carreño et al., 2007). It combines a physical damage risk index (see Table 3.2.1a), which is computed through loss scenarios and describes building damage and infrastructure losses, with an impact factor consisting of socio-economic fragility and the lack of societal resilience indicators (see Table 3.2.1b) that aggravate the physical risk of damage from a hazard event. The total earthquake risk is expressed as:

$$R_T = R_F\,(1+F),$$

where R_T is the total risk index, R_F is the physical risk index and F is the impact factor. The impact factor (F) is the weighted sum of a set of aggravating factors related to the socio-economic fragility and the lack of resilience. For the full equation, please refer to Carreño et al. (2007, p. 142).

The social fragility and lack of resilience curves are based on sigmoid functions, with the values of each function calculated using data from past disasters and the Analytical Hierarchic Process (AHP) by international experts (Carreño et al., 2007). AHP is a decision-making technique that is based on the process of paired comparisons of different ideas, factors, or attributes (Saaty, 2008). The curves describe the intensity of the risk for each indicator.

Table 3.2.1a. *Physical risk indicators*

Concept	Indicator	Variable
Physical risk	Damaged area	Percentage (damaged area/build area)
	Dead people	Number of dead people each 1,000 inhabitants
	Injured people	Number of injured people each 1,000 inhabitants
	Ruptures in water mains	Number of ruptures/Km^2
	Ruptures in gas network	Number of ruptures/Km^2
	Fallen lengths of HT power lines	Metres of fallen lengths/Km^2
	Telephone exchanges affected	Vulnerability index
	Electricity substations affected	Vulnerability index
	Damage in the road network	Damage index

Note. From "Urban seismic risk evaluation: A holistic approach", by M.L. Carreño, O.D. Cardona, and A.H. Barbat, 2007, *Natural Hazards, 40*(1), p. 146.

Table 3.2.1b. *Aggravating indicators and their units*

Concept	Indicator	Variable
Social fragility	Slums-squatter neighbourhoods	Slum-squatter neighbourhoods area/Total area
	Mortality rate	Number of deaths each 10,000 inhabitants
	Delinquency rate	Number of crimes each 100,000 inhabitants

	Social disparity index	Index between 0 and 1
	Population density	Inhabitants/Km^2 of build area
Lack of resilience	Hospital beds	Number of hospital beds each 1,000 inhabitants
	Health human resources	Health human resources each 1,000 inhabitants
	Public space	Public space area/Total area
	Rescue and firemen manpower	Rescue and firemen manpower each 10,000 inhabitants
	Development level	Qualification between 1 and 4
	Risk management index	Index between 0 and 1

Note. From "Urban seismic risk evaluation: A holistic approach", by M.L. Carreño, O.D. Cardona, and A.H. Barbat, 2007, *Natural Hazards, 40*(1), p. 146.

The resulting evaluation of earthquake risks was conducted for Bogota, Colombia and Barcelona, Spain.

3.2.2 Social Vulnerability Index (SoVI)

One of the most cited social vulnerability indices is the SoVI by Cutter et al. (2003). Since its development in the early 2000s, the index has undergone significant revision. The latest itineration is shown in Addendum A3.24. The index (or variations of it) has been used to determine the extent to which social vulnerability is associated with earthquake losses. Building on the research by Rashed and Weeks (2003), Schmidtlein et al. (2011) examined the spatial linkages between social vulnerability and estimated earthquake losses under different scenarios. Using the HAZUS-MH software, a US-based risk assessment tool developed by the Federal Emergency Management Agency (U.S. Department of Homeland Security, 2015), the study conducted regression analyses to evaluate whether SoVI is predictive of earthquake losses.

To evaluate the extent to which SoVI is correlated with earthquake losses, Schmidtlein et al. (2011) first modelled earthquake losses using the HAZUS-MH software, which includes primarily physical attributes of hazards and fragility algorithms. Then social vulnerability is modelled for the study area (Charleston, South Carolina, USA). Adapting the indicators listed in SoVI, the indicators used for the social vulnerability model in the regression analyses are listed in Table 3.2.2.

Table 3.2.2. *Variables used to model social vulnerability*

Variable	
Percent female	Average number of people per household
Percent female headed households	Percent population under 5 years
Percent population over 25 years old with less than 12 years of education	Percent population 65 years or older
	Percent institutionalised elderly population
Median gross rent ($) for renter-occupied housing units	Percent renter-occupied housing units
Average family income	Median dollar value of owner occupied housing units
Percent living in poverty	Percent rural farm population
Percent households that receive social security benefits	Percent employed in primary industry
Percent of population who are immigrants	Percent employed in transportation, communications, and other public utilities
Percent Asian or Pacific Islander	
Percent black population	Percent of the population living in urban areas
Percent Native American population	Percent employed in service occupations
Percent Hispanic persons	Civilian labour force participation
	Percent of the civilian labour force unemployed
	Percent female participation in civilian labour force

Note. From "Modeled earthquake losses and social vulnerability in Charleston, South Carolina", by M.C. Schmidtlein, J.M. Shafer, M. Berry, and S.L. Cutter, 2011, *Applied Geography, 31*(1), p. 274.

By analysing the relationships between the modelled earthquake losses (i.e., total tons of debris generated and direct economic losses), the regression models found that the physical event parameters, as expected, have a bigger influence on earthquake losses than social vulnerability factors. However, social vulnerability factors are found to have significant relationships with earthquake losses. Areas with higher social vulnerability experience higher total losses relative to the average incomes of the area. This indicates that in areas with higher social vulnerability, the impact of the losses is greater (Schmidtlein et al., 2011). The authors suggested that areas with high social vulnerability are often poorer and have less capacity to overcome economic losses than areas with low social vulnerability. Although areas with low social vulnerability experience greater economic losses due to higher values of assets, they are more equipped to absorb and recover from such losses.

3.2.3 Other social vulnerability indicators associated with earthquake losses

Race/ethnicity, income, and tenure

In a related study using HAZUS-MH, Noriega and Ludwig (2012) assessed the associations between social vulnerability factors and modelled earthquake losses in Los Angeles County, California and its 88 incorporated cities. Social vulnerability variables include socioeconomic status, race, and tenure, and earthquake losses are comprised of economic losses and social losses (see Table 3.2.3).

Table 3.2.3. *Independent and dependent variables used in regression analysis*

Social Vulnerability Variables	Economic Losses	Social Losses (per 1,000 residents)
Socioeconomic status (income) Race/ethnicity: White (non-Hispanic) Hispanic Black (non-Hispanic) Tenure: % of residential units occupied by renter(s)	Capital Stock Losses: Structural damage Non-structural damage Contents damage Inventory loss Income Losses: Relocation loss Capital-related loss Wages loss Rental income loss	Fatalities (number of deaths per city) Trauma injuries (number of people requiring trauma care and hospitalisation per city) Other hospitalised injuries Injuries requiring Emergency Department visits (without hospitalisation) Injuries treated on an outpatient basis Hospital visits requiring emergency medical services (EMS) transport

Note. From "Social vulnerability assessment for mitigation of local earthquake risk in Los Angeles County", by G. Noriega and L. Ludwig, 2012, *Natural Hazards, 64*(2), p. 1341-1355.

Results of the study revealed significant correlations between social vulnerability variables and earthquake losses (Noriega & Ludwig, 2012). Significant relationships were found between economic losses and ethnicity, in which economic losses were positively associated with the percentage of White residents in the cities and negatively associated with the percentage of Hispanic residents. Economic losses were also found to be negatively associated with median household income (MHHI). The only association between social vulnerability variables and social losses was with the cities' Hispanic population – the potential of social losses increased as the percentage of Hispanic population increased. Table 3.1.7 describes the extent of correlations between the social factors and earthquake losses.

Table 3.2.4. *Mean, standard deviations, and zero-order correlations between social vulnerability variables and potential earthquake losses (n = 88)*

Variable	Mean	SD	White	Black	Hispanic	Renter	MHHI	Casualties
White	38.12	27.92						
Black	5.21	8.30	-.279**					
Hispanic	39.69	29.78	-.838**	.030				
Renter	42.72	20.28	-.440**	.155	.519**			
MHHI	58.13	31.51	.667**	-.256*	-.619**	-.710		
Social losses	6.15	26.41	-.152	-.096	.216*	.164	-.053	
Economic losses	2.00	1.29	-.424**	-.151	.445**	.105	-.380**	.421**

*$p < .05$; ** $p < .01$

Note. From "Social vulnerability assessment for mitigation of local earthquake risk in Los Angeles County", by G. Noriega and L. Ludwig, 2012, *Natural Hazards, 64*(2), p. 1347.

Regression analysis was also conducted to develop a model for predicting economic losses and social losses from the social vulnerability variables (Noriega & Ludwig, 2012). For economic losses, results from the analysis found that economic losses are associated with cities that have a higher proportion of minority residents, higher proportion of lower income residents, and a lower rate of renter occupied resident units. For human losses, the potential rate of casualty is associated with higher rate of lower income residents, renter occupied units and minority residents.

Specifically, results of the analysis revealed that social vulnerability variables accounted for 23.2% of the variance in potential economic losses (Noriega & Ludwig, 2012). Among all social vulnerability variables, the level of household income was the most important predictor of economic losses. In terms of social vulnerability predicators of casualty rate, a number of variables demonstrated significant relationships (Noriega & Ludwig, 2012). Race and ethnicity had different effects on potential casualty rate – positive association was found for Hispanics, negative association for Blacks, and no association for Whites. Socioeconomic status was found to be negatively associated with potential casualties, but tenure was shown to be positively associated with social losses.

Urban growth and population exposure

The Disaster Risk Index was constructed by Peduzzie et al. (2009) based on modelling of various factors that had influenced the levels of human losses from four types of natural hazards (i.e., droughts, floods, cyclones, and earthquakes) at the global scale between 1980 and 2000. Of the 32 variables that were tested against the mortality data in EM-DAT (Emergency Disasters Data Base), the authors found three variables that contributed to the rate of casualties from earthquakes. Both high urban growth and population exposure were significantly correlated to an increase in loss of life, while forest coverage was negatively associated with earthquake deaths. Potential explanations of the relationship between urban growth and earthquake deaths include the possibility that urban growth may be associated with poor urban planning and building standards, or that new residents are moving into and living in at-risk areas (Peduzzi et al., 2009). The percentage of forest coverage may be related to higher risk of landslides in earthquake prone areas as a result of deforestation of slopes (Peduzzi et al., 2009).

Access to health services

As described in previous sections, social vulnerability indicators usually consist of income, age, gender, employment rate, and tenure (or homeownership). Walker et al. (2014) incorporated not only physical and social vulnerability variables as part of the vulnerability spatial assessment of Victoria, British Columbia, but also distances to hospitals (driving time and walking time), (see

Addendum A3.22). Although no regression analysis was conducted to determine potential predictors of economic and social losses from earthquakes, this study expands the concept of social vulnerability to include not only the availability of health services, but also examines the linkages of access to medical services to health outcomes, which have been demonstrated to be closely related (Higgs, 2009; McLafferty, 2003).

RiskScape already incorporates road assets as part of its asset module and it would be logical to include distances and travel times to existing medical facilities. However, like other social vulnerability variables, further examination of health access variables needs to be conducted with locally available data to decipher any confounding relationships between health assets (e.g. number of general practitioners, hospital beds) and accessibility characteristics (e.g., travel time to health centre, availability of cars, and perceptions of health services utilisation based on individual beliefs, culture, and gender) with health outcomes from earthquake impacts (e.g., mortality and morbidity). For instance, in a study by Johnston et al. (2014), injury rates could be related to a variety of societal provisions and constraints (e.g., availability of low-cost health services and thus resulting in higher reporting) and gender norms.

3.3 Social vulnerability indicators as fragility functions: Challenges and opportunities

The transformation of social vulnerability indicators into fragility functions in risk modelling needs to be further evaluated. Based on existing studies, the associations between social vulnerability variables and earthquake losses (both social and economic) are tenuous. Hazards researcher David Johnston (pers. comm., 2015) suggested social vulnerability factors should not be used to predict human losses. As the Christchurch earthquakes have demonstrated, earthquake morbidity rates did not conform with other international studies and trends (Johnston et al., 2014). Moreover, the author of this report could not find any studies that used social vulnerability variables (e.g., age, sex, income) as direct input in social and economic risk modelling. The lack of any attempts might be due to previously discussed findings that earthquake losses such as mortality, morbidity, displacement, and economic impacts are primarily attributed to physical characteristics of the event itself. Although social vulnerability factors are associated with earthquake impacts, the relationships are strongly influenced by local contexts, and no single social vulnerability variable has been shown to affect earthquake losses across different localities, earthquake events, and timescale.

However, the lack of generalisability of individual social vulnerability indicators on earthquake losses does not mean social vulnerability indicators should not be used to predict earthquake losses. Instead of using individual social vulnerability variables as predictors, a composite of variables should be developed and tested against modelled earthquake loss outputs. This might help refine the types of variables that strongly influence earthquake impacts within the New Zealand context. The author of this report recommends employing similar methods as those used by Rashed and Weeks (2003) and Schmidtlein et al. (2011) to determine which social vulnerability variables demonstrate the greatest influences on earthquake impacts for each of the earthquake scenarios. The methods would consist of three stages:

1. Running earthquake models in the RiskScape software;
2. Selecting New Zealand-based social vulnerability indicators using the AHP process or available census data (a list of potential variables is shown in Table 3.2). Test indicators for internal validity and run social vulnerability models using methods employed by Cutter et al. (2003); and
3. Conducting regression analysis between model outputs.

The outcomes of the results might provide insights as to whether social vulnerability indicators are appropriate for use in modelling earthquake impacts in RiskScape.

Table 3.2. *Potential New Zealand-based vulnerability indicators to be modelled. Adapted from SoVI 2006-2010*

Social vulnerability indicator	Potential variable
Poverty	Percent poverty Percent of housing units with no car Percent female headed households Percent renters Percent civilian unemployment Percent with less than 12th grade education Percent employment in service industry Percent of children living in married couple families
Race and ethnicity	Percent non-European Percent speaking English as a second language with limited English proficiency
Wealth	Median house value Percent of householders earning greater than NZD$XXX,XXX annually Per capital income
Age (elderly)	Percent of households receiving superannuation Percent of population under 5 years or 65 and over Median age People per unit
Gender (female)	Percent female Percent female participation in labour force
Care dependency, medical disability, and health care access	Percent of population living in nursing and skilled-nursing facilities Percent of population with disability Hospitals per capita

Note. Retrieved from http://webra.cas.sc.edu/hvri/products/sovi_details_2006.aspx.

3.4 Social vulnerability indicators as a resource module: Challenges and opportunities

Once the previously suggested testing has been done, it is recommended that social vulnerability and resilience data be input into RiskScape through the creation of 'resource' datasets. These datasets would overlay (i.e., map) with the aggregated asset impacts and losses (see bolded component in Figure 3.3). The overlay of social vulnerability datasets would provide both temporal and spatial measurements of vulnerability. When earthquake loss outputs are combined with social vulnerability maps, the following questions that are pertinent to emergency managers and planners can be answered:

- Who are the most vulnerable in a given impact scenario?
- Where are the most vulnerable people located?
- What community assets exist that can potentially alleviate the impacts of a disaster?
- What gaps exist in terms of physical and human disaster response infrastructure and assets?
- Where are these assets in relation to vulnerable populations?
- Which communities are prepared to recover given the existing levels of vulnerability?

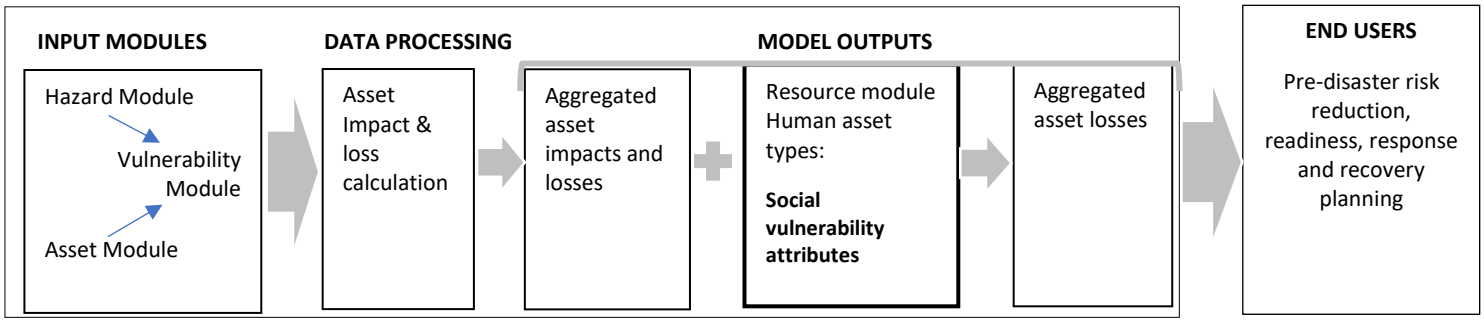

Figure 3.3. Vulnerability exposure and resilience dataset overlay in earthquake risk modelling. Retrieved and adapted from https://wiki.riskscape.org.nz/index.php/RiskScape_Model.

Based on existing literature, an initial list of potential social vulnerability indicators in Table 3.3 are recommended for inclusion in RiskScape's resource modules. These indicators are independent of hazard types. Data for most of these indicators are readily available from Statistics New Zealand (Statistics New Zealand, 2015a).

Table 3.3. *Potential social vulnerability indicators to be included in resource modules*

Social vulnerability indicator	Potential variable
Poverty	Percent poverty Percent of housing units with no car Percent of housing with no access to internet or telephone Percent renters
Race and ethnicity	Percent non-European Percent speaking English as a second language with limited English proficiency
Wealth	Percent of householders earning less than NZD$XX,XXX annually
Age (elderly)	Percent of households receiving superannuation Percent of population under 5 years or 65 and over
Care dependency, medical disability, and health care access	Percent of population living in nursing and skilled-nursing facilities Percent of population with disability Hospitals and health centres

Furthermore, end users of RiskScape might prioritise certain social vulnerability indicators than others. In the following sections, social vulnerability indicators that are pertinent to two end user segments – emergency management practitioners and health practitioners – are proposed.

3.4.1 Civil Defence: Social vulnerability indicators based on the 4 R's

In New Zealand, emergency management revolves around the four phases – or the 4 Rs – of disaster (Ministry of Civil Defence and Emergency Management, n.d.). The four Rs are:

- Reduction: This phase includes activities related to the identification and analysis of long-term hazard risks to people and properties, as well as the elimination and reduction of risks and consequences;
- Readiness: This phase includes activities that seek to develop the capacity of people and institutions before a disaster happens, and they may include preparedness and response programmes for the public, as well as programmes specific to societal functions during a disaster such as emergency agencies, lifeline utilities, and other agencies;
- Response: This phase includes activities that are taken immediately before, during or directly after a disaster to save lives, protect property, and help communities to recover; and

- Recovery: This phase includes coordinated efforts and processes among people and agencies that help facilitate immediate, medium-term and long-term regeneration of communities following a disaster.

With these 4Rs in mind, a list of potential social vulnerability indicators in Table 3.3.1 may be pertinent to Civil Defence practitioners.

Table 3.3.1. *Social vulnerability indicators for the 4Rs*

Social vulnerability indicator	Potential variable
REDUCTION in people's vulnerability	Percent poverty Percent of people receiving a means tested benefits Percent of housing units with no car Percent of housing with no access to internet or telephone Percent speaking English as a second language with limited English proficiency Percent of population under 5 years or 65 and over Percent of population living in nursing and skilled-nursing facilities Percent of population with disability
READINESS in social capacity	Number of first responders Percent volunteerism Emergency planning benchmarking
RESPONSE to social needs	Number of schools per 10,000 population Number of community centres/*maraes* per 10,000
RECOVERY of social functions	Percent unemployment Percent employment in extractive or agricultural industries Number of homeowners with insurance

3.4.2 Social vulnerability indicators for health practitioners

Features and characteristics of the human system such as individual and community vulnerability, accessibility to health services, and societal capacities to respond to health and medical needs contribute to the reduction of human losses and improve health outcomes from natural hazard events (Ardagh et al., 2012; Hasegawa, 2013; Kolbe et al., 2010; Liang et al., 2001). Potential indicators that address these three axes of health services and access are listed in Table 3.3.2.

Table 3.3.2. *Health services and access indicators*

Social vulnerability indicator	Potential variable
Medically vulnerable populations	Percent of population under 5 years or 65 and over Percent of population living in nursing and skilled-nursing facilities Percent of population with disability and other chronic conditions
Health access	Percent of housing units with no car Percent of housing with no access to internet or telephone Percent speaking English as a second language with limited English proficiency Percent of population with less than XX level of education Access to health care services (distance and time)
Health services capacity	Number of hospital beds Number of mental health facilities Number of GPs and health professionals per 1,000

It is recommended that the indicators in Tables 3.3.1 and 3.3.2 be refined through consultation with RiskScape's end users, so that the resulting outputs provide the necessary information for their needs.

4.0 Conclusion

It is important to recognise that social vulnerability spans both spatial and temporal scales, so the levels of social vulnerability of a particular class of people, for instance, may change from one place to another or from one point in time to another. Moreover, the interdependencies of vulnerability variables with other contextual conditions shape the formation of vulnerabilities.

This dynamism of vulnerability presents significant challenges for risk models, but that does not mean social vulnerability indicators should not play a role in risk modelling. In fact, the inclusion of social vulnerability in risk modelling is crucial to a holistic assessment of hazard risks that captures the potential vulnerabilities before a hazard event, and the consequences of the impacts on people and the economy. On the one hand, social vulnerability information in risk models may offer end users the necessary knowledge so they can mitigate certain risks and prepare vulnerable populations for a potential hazard event. On the other hand, it provides information that will become useful in disaster response and recovery.

There are key issues that need to be considered when incorporating social vulnerability indicators in risk models. Stephen and Downing (2001, p. 114) argue that "vulnerability assessments must be methodologically sound and context sensitive." They must also "measure the right things, at the right scale, with suitable conceptual underpinning" (Downing, 2001, p. 114). As such, the selection of social vulnerability indicators, therefore, requires an understanding of their linkages to other physical, political, economic and environmental contextual factors. It is also crucial to evaluate the purpose of and potential for measuring social vulnerability beyond predicting earthquake economic and human losses. It might be important to align aspects of social vulnerability modelling outputs with potential recovery objectives of local communities. As in the case of post-Christchurch earthquakes, the evaluation of socioeconomic recovery (i.e., Canterbury Wellbeing Index (Canterbury Earthquake Recovery Authority, 2014) in areas such as knowledge and skills, economic wellbeing, housing, health, safety, social connectedness, civic participation, and population dynamics might be a good starting point for 'working backwards' on what social vulnerability indicators should be included in RiskScape. Further exploration of the following questions will aid the selection of social vulnerability indicators for inclusion in RiskScape:

- What information would users of RiskScape need before and after a disaster?
- At what scale does the information need to be presented so that the decision-making process is more manageable and effective?
- How will user-driven needs be incorporated into the selection of social vulnerability indicators?
- What methods will be used to select the most appropriate social vulnerability indicators that are locally relevant?

ADDENDUM

A1.0 Associations between social vulnerability and earthquake mortality and morbidity

A1.1 Social vulnerability variables on increased mortality rates

	Age - Elderly	Age - Children	Age – With increasing age	Sex – Female	Physical Disability	SES - Low
Statistically significant	Miyano et al., 1996 Tanida 1996 Glass et al., 1977	Chou et al., 2004 Glass et al., 1977	Chan et al., 2003 Peek-Asa et al., 2003 Mahue-giangreco et al., 2001 Armenian et al., 1997 Tanaka et al., 1999			Chou et al., 2004
No difference	de Bruycker et al., 1985			de Bruycker et al., 1985 Chan et al., 2003		
Confounding variables/influences noted	Osaki & Minowa, 2001 Tanida, 1996: Exposure Shoaf et al., 1998: Cultural factors	Glass et al., 1977: Cultural/ malnutrition Guha-Sapir & Vos, 2011: Parental care priorities			Osaki & Minowa, 2001	

A1.2 Social vulnerability variables on increased injury rates

	Age – Elderly	Age – Young and/or Working Age Adults	Age – With increasing age	Age – Children	Sex – Female	Transients (Tourists & Students)	Low SES	Low Education	Single/ Widowed
Statistically significant	Sami et al., 2009 McArthur et al, 2000	Ganjouei et al., 2008 Mulvey et al., 2008 Sami et al., 2009	Peek-asa et al., 1998 Tanaka et al., 1999 Mahue-Giangreco et al., 2001 Peek-Asa et al., 2003 Doocy et al., 2009 Chou et al., 2004	Sami et al., 2009	Peek-Asa et al., 2003 Najafi et al., 2009 Glass et al., 1977 Chan et al., 2003 Chou et al., 2004 Armenian et al., 1997	Roces et al., 1992	Doocy et al., 2009 Milch et al., 2010		Roces et al., 1992

Not statistically significant	Doocy et al., 2013 Roces et al., 1992 Shoaf et al., 1998, p223: Inconsistent between three CA earthquakes	Shoaf et al., 1998: Lower rate of injuries		Roces et al., 1992 McArthur et al., 2000: Decreased risk among children	Doocy et al., 2013 Sami et al., 2009 Shoaf et al., 1998, p223: Inconsistent between three CA earthquakes		Guha-Sapir & Vos, 2011 Shoaf et al., 1998	Doocy et al., 2013 Shoaf et al., 1998: Less injuries for less educated (self-reported injuries)	Shoaf et al., 1998: Married/living together

A1.3 Social vulnerability variables on both injury and mortality rates

	Age - Elderly	**Age – Children**	**Sex – Female**	**Sex – Male**	**Physical Disability**	**Mental Disability**	**Transients (Tourists & Students)**	**Low SES**	**Low Education**	**Single/ Widowed**
Statistically Significant	Glass et al., 1977 Miyano et al., 1996 Mahue-Giangreco et al., 2001 Chou et al., 2004 Aroni & Durkin, 1985 Peek-Asa et al., 2001 Doocy et al., 2009 Doocy et al., 2013 Sullivan, 2010 Armenian et al., 1997 Tanaka et al., 1999 Chan et al., 2003 Tanida, 1996 Eberhart-Phillips et al., 1994	Chou et al., 2004 Sami et al., 2009 Sullivan, 2010 Glass et al., 1977 Parasuraman, 1995 Tanaka et al., 1999 Liang et al., 2001 Pawar et al., 2005	Chou et al., 2004 Peek-Asa et al., 2003 Glass et al., 1977 Peek-Asa et al., 2001 Shoaf et al., 1998 Sami et al., 2009 Chan et al., 2003 Armenian et al., 1997 Liao et al., 2003 Parasuraman, 1995		Osaki & Minowa, 2001 Chou et al., 2004	Chou et al., 2004	Roces et al., 1992	Chou et al., 2004 Doocy et al., 2009 Milch et al., 2010 Sami et al., 2009	Milch et al., 2010	Roces et al., 1992

	Peek-asa et al., 1998 Liang et al., 2001 Liao et al., 2003 Sullivan, 2010									
Descriptive	Zhang et al., 2009	Zhang et al., 2009	Mahue-Giangreco et al., 2001 Liang et al., 2001	Armenian et al., 1997 Dhar et al., 2007 Ganjouei et al., 2008 Mohebbi et al., 2003 Mulvey et al., 2008						
No difference	de Bruycker et al., 1985 Peek-Asa et al., 2003 Liao et al., 2003		Osaki & Minowa, 2001 Eberhart-Phillips et al., 1994 Liao et al., 2003?							
Confounding variables/ influences noted	Osaki & Minowa, 2001									

A1.4 Behaviour on injuries

	Stayed indoors	Trying to Escape Outside	Moving	Notes
Significant	Hogg, 1980 Armenian et al., 1992 Roces et al., 1992 Angus et al., 1997 Peek-asa et al., 1998	Aroni & Durkin, 1985	Shoaf et al., 1998	Inconsistencies are "not necessarily contradictory because exiting from a poorly-built collapsing structure may protect against death while attempts to exit buildings that do not collapse may increase risk for injury" (Peek-Asa et al., 2001).

A1.5 Behaviour on mortality

	Stayed indoors	Trying to Escape Outside	Moving	Night time	Day time
Statistically Significant	Hogg, 1980 de Bruycker et al., 1985	Armenian et al., 1992		Alexander, 1996	Lomnitz, 1970
Descriptive	Armenian et al., 1992 Parasuraman, 1995 Angus et al., 1997 Tanaka et al., 1999 Ellidokuz et al., 2002		Johnston et al., 2014		

A2.0 Selected vulnerability indices, tools, and checklists

#	Measure name (authors)	Type	Type of Hazards	Method	Spatial/study unit	Application Area	Domain	Main Concepts Measured
1	Canterbury Wellbeing Index (Canterbury Earthquake Recovery Authority, 2014)	Index	Earthquake	Bottom up	Community	Canterbury region, New Zealand	Capacities/ characteristics	Knowledge and skills, economic wellbeing, housing, health, safety, social connections, civil participation, people
2	Climate hazards vulnerability (de Sherbinn et al., 2007)	Tool	Climate-related hazards	Top down	City	Mumbai, Rio de Janeiro, Shanghai	Capacities/ characteristics	Physical environment, infrastructure, socioeconomic conditions
3	Climate hazards vulnerability (Brooks et al., 2005)	Index	Climate-related disasters	Top down	National	Global	Characteristics	Economy, health and nutrition, education, infrastructure, governance, geography and demography, agriculture, ecology, technology
4	Disaster Management Community Baseline Data (Good & Dufresne, 2001)	Checklist	All hazards	Top down	Community	A component of VCA (International Federation of Red Cross and Red Crescent Societies, 2007)	Capacities/ characteristics	Location of community, physical description of community, climactic conditions, demographics, local contacts/ organisations/ authorities, human vulnerability, health and nutritional conditions, health services, physical vulnerability, infrastructure and access, food, housing and shelter, water, sanitation
5	Disaster Risk Index (Peduzzi et al., 2009)	Index	Droughts, floods, cyclones, earthquakes	Top down	National	Global	Characteristics	Economic, economic activities, quality of the environment, demography, health and sanitation, politics, early warning capacities, education, development
6	DPSIR (Bowen & Riley, 2003)	Tool	Environmental hazards	Top down	Community		Characteristics	Population dynamics, economic conditions, social conditions and cultural traditions, development pressure/capital construction, habitat change/ecological value, contaminant introduction, resource extraction activities, human uses/activities
7	Environmental Performance Index (Yale University, 2014)	Index	Environmental harm relating to water resources,	Top down	National	Global	Characteristics	Environmental health

			agriculture, forests, fisheries, biodiversity and habitat, climate and energy					
8	F'ANP SOVI (Zebardast, 2013)	Index	Earthquake	Top down	Counties	Iran	Characteristics	Housing deprivation, unemployment, dependent population, less development, income deprivation, females and migration, health and infrastructure deprivation
9	Human Development Index (United Nations Development Programme, 2014a)	Index	None-specified	Top down	National	Global	Characteristics	Longevity, education, economic productivity
10	Index of Social Vulnerability to Climate Change for Africa (Vincent, 2004)	Index	Climate-related hazards	Top down	National	Africa	Characteristics	Economic well-being and stability, demographic structure, institutional stability and strength of public infrastructure, global interconnectivity, natural resource dependence
11	Livelihood Vulnerability Index (Hahn et al., 2009)	Index	Climate-related hazards	Bottom up	Community	Mozambique (Hahn et al., 2009); India (Madhuri, et al., 2014)	Capacities/ characteristics	Socio-demographic, livelihood, health, social networks, food, water, natural disasters and climate variability
12	MOVE (J. Birkmann et al., 2013)	Tool	All hazards	Top down	City	Barcelona urban area (earthquake); Cologne (floods)	Capacities/ characteristics	Physical, ecological, social, economic, cultural, institutional
13	Multidimensional Poverty Index (United Nations Development Programme, 2014c)	Index	None-specified	Top down	National	Global	Characteristics	Education, health, living standards
14	NZ Deprivation Index (Atkinson et al., 2014)	Index	None-specified	Top down	Community	New Zealand	Characteristics	Socio, economic

15	NZ Neighbourhood Fragmentation Index (Ivory et al., 2012)	Index	None-specified	Top down	Community	New Zealand	Characteristics	Socioeconomic
16	Predictive Indicators of Vulnerability (Adger et al., 2004)	Index	Climate-related hazards	Top down	National	Global	Capacities/ characteristics	Economic well-being, health and nutrition, education, physical infrastructure, institutions/governance, conflict/social capital, geography and demography, dependence on agriculture, natural resources and ecosystems, technical capacity
17	Prevalent Vulnerability Index (Cardona, 2005)	Index	All hazards	Top down	National	Latin America	Capacities/ characteristics	Exposure and susceptibility, socioeconomic, lack of resilience
18	Resilience Index New Zealand (Pearson et al., 2013)	Index	Health (physical and mental health)	Top down	Community	New Zealand	Capacities/ characteristics	Culture, community participation, rurality, cohesion
19	Social Flood Vulnerability Index (SFVI) (Tapsell et al., 2002)	Index	Floods	Top down	Community	United Kingdom	Characteristics	Social, economic
20	Social Vulnerability Index (Agency for Toxic Substances and Disease Registry, 2014)	Index	All hazards	Top down	Community	US	Characteristics	Socioeconomic, household composition, minority status/language, housing/transportation
21	Social Vulnerability Index (Rygel et al., 2006)	Index	Storm surges	Top down	Community	The Hampton Roads, Virginia metropolitan region, US	Characteristics	Social (poverty, immigrants, old age/disabilities)
22	Social Vulnerability Index (Walker et al., 2014)	Index	Earthquakes	Top down	Community	British Columbia, Canada	Characteristics	Social, physical, systemic (health access)
23	Social vulnerability indicators (Dwyer et al., 2004)	Index	All hazards, with focus on floods	Bottom up	Community	Perth, Australia	Capacities/ characteristics	Socioeconomic

24	Social Vulnerability Index (SoVI) (Cutter et al., 2003)	Index	All hazards	Top down	Sub-national	Charleston, South Carolina (Schmidtlein et al., 2011) US counties (Cutter et al., 2003); New Orleans, US (Finch et al., 2010); US cities Portugal (de Oliveira Mendes, 2009); Norwegian municipalities (Holand, Lujala, & Rød, 2011)	Characteristics	Social
25	Social Vulnerability Index (SoVI) – China (Lixin et al, 2014)	Index	All hazards	Top down	City	China	Characteristics	Social
26	Urban Indicators (Cardona, 2005)	Index	All hazards	Top down	City	Bogotá, Colombia	Characteristics	Physical risk, impact factor
27	Urban Risk Evaluation (Carreño et al., 2007)	Index	All hazards, with focus on earthquakes	Bottom up	Community	Bogota, Colombia; Barcelona, Spain	Characteristics	Social
28	Vulnerability and Capacity Assessment (International Federation of Red Cross and Red Crescent Societies, 2007)	Tool	All hazards	Bottom up	Community	Non-specified	Capacities/ characteristics	Natural, physical, financial, human, social
29	The Vulnerability Sourcebook (Fritzsche et al., 2014)	Tool	Climate-related hazards	Top down	National	Non-specified	Capacities/ characteristics	Climatic stimuli, bio-physical, social-economic, loss/impact/policy indicators

A3.0 Vulnerability indices and indicators

A3.1 Canterbury Wellbeing Index (Canterbury Earthquake Recovery Authority, 2014)

Concept	Operationalized variable(s)
Knowledge and skills (Participation in education and educational achievement)	Rate of early childhood education participation
	Rate of student absences
	% of 15-24 years old not in education, employment or training
	Number of tertiary enrolments
	Age-standardised rate for stand-downs, expulsions, suspensions and exclusions per 1,000 students
	Number of student transience
	Proportion of 16-year-old who attended NCEA Level 2 or a higher qualification
	Proportion of ethnicity of school leavers who attained NCEA Level 2 or a higher qualification
Economic wellbeing (Employment outcomes and household income)	Proportion of beneficiaries leaving a benefit for employment
	Unemployment rate
	Employment rate
	Number of work-related injury claims per 1,000 FTE
	Median gross weekly household income (homeowners and renters)
Housing (Housing affordability and availability)	Proportion of renting households with less than $480 of gross weekly household income net housing costs
	Mean house sale price
	Number of houses sold
	Mean weekly rent
	Percentage of rental bonds lodged monthly by weekly rent level
	Number of rental listings on Trade Me
	Proportion of habitable HNZC and CCC housing units
	Number on CCC and HNZC/MSD waiting lists
	Number of households displaced due to residential repair of rebuild
	Percent of households who spend more than 30% of household income on housing
Health (Keeping well and having access to health services; mental wellbeing; risk factors)	Number of acute general medical admissions
	Weekly influenza-like illness rate
	Barriers to health care for adults in the past 12 months (NZ Health Survey)
	Immunisation rates for two-year-olds and eight-month-olds
	Overall quality of life reported as good or extremely good
	Proportion of respondents reporting high levels of stress
	Percent of population with a WHO-5 score less than 13
	Number of calls to the Canterbury Support line
	Households registered with Earthquake Support Coordination Service
	Number of attendances for brief intervention counselling by age
	Number of clients accessing mental health services (by service type and age)
	Average Health of the National Outcome Scales (HoNOS) score for clients accessing community mental health services
	Distribution of Index of Severity for clients accessing community health services
	Percent of clients in the clinical range accessing community health services
	Number of anti-depressant units dispensed
	Number of anti-anxiety units dispensed
	Number of new clients that have contacted Gambling Helpline

	Number of problem gamblers assisted by an intervention service
	Number of days of air quality breaches each year
	Winter heating installations
	Proportion of the Year 10 population who are daily smokers
	Proportion of adult population who are current smokers
	Proportion of Canterbury and New Zealand residents who are current smokers, obese, or hazardous drinkers
Safety (Offending patterns; child abuse and neglect)	Number of assault-related offences per year
	Three-month rolling average of the number of final protection orders
	Number of property-related offences by year
	Apprehensions for offences reported to the police
	Rate of re-imprisonment
	Rate of community offender reconviction
	Three-month rolling average of the number of CYF (Child, Youth and Family) notifications requiring further action
	Number of substantiated findings of child abuse or neglect per year
Social connections (People participate in and attend the arts; sports participation; Households are prepared for civil defence emergencies; social connectedness)	Proportion of all people (aged 15 years and over) who attend arts events
	Total memberships for Canterbury regional sports organisations
	Proportion of people who said their household has all the items needed for disaster preparation
	Percentage of residents who felt a sense of community
	Proportion of residents reporting they had someone they could turn to for help during a difficult time
	Volunteering rate
	Graffiti and noise complaints
Civil participation	Confidence in earthquake recovery decision-making (%)
	Satisfaction with earthquake recovery communications and information
	Satisfaction with opportunities to influence decisions
	Voter turnout in local government elections for councillors
	Voter turnout in general elections
People (Population)	Population estimates
	Percentage change in population
	Occupied private dwellings
	Net permanent and long-term migration

A3.2 Climate hazards vulnerability (de Sherbinn et al., 2007)

Concept	Operationalized variable(s)
Socioeconomic stresses	Population growth
	Economic downturn
	Globalisation
Socioeconomic conditions Direct coping abilities	Early warning system
	Evacuation plan
	Disaster management plan
	Appropriate zoning
	Dikes or other armaments
	Building codes
Indirect coping (social capital)	Percent migrants
	Crime rate
	Single-parent households

	Voter turnout
	Households with secure tenure

A3.3 Climate hazards composite vulnerability index (Brooks et al., 2005)

Concept	Operationalized variable(s)
Education	Literacy rate, 15-24 year olds
	Literacy rate, over 15 years
	Literacy ratio (female to male)
Governance	Voice and accountability
	Civil liberties
	Political rights
	Government effectiveness
Health status	Population with access to sanitation
	Maternal mortality
	Calorific intake
	Life expectancy at birth

A3.4 Disaster management community baseline data (Good & Dufresne, 2001)

Concept	
Location of community	Physical vulnerability of the community
Physical description of community	Infrastructure and access
Climactic conditions	Food
Demographics of the community	Housing and shelter
Local contact information	Water
Local authorities, organisations	Sanitation
Human vulnerability to disasters	Planning/preparedness
Health and nutritional conditions	Emergency response resources
Health services	Local capacities for disaster mitigation and response

A3.5 Disaster Risk Index (Peduzzi et al., 2009)

Concept	Operationalized variable(s)
Economic	GDP purchasing power parity per capita
	Percentage of arable land
	Value of crop land
Population growth	Percentage of urban growth
	Population exposure
Environmental	Percentage of country forest coverage

A3.6 Driver-Pressure-State-Impact-Response (DPSIR) indicators (Bowen & Riley, 2003)

Concept	Operational variable(s)		
	Driver/state	**Pressure**	**Impact**
Population dynamics	Resident coastal population		
	Coastal land-use/land cover		
	Coastal zoning patterns		
Economic conditions	Annual GDP growth		
	Environmentally adjusted net domestic product		
	Economic value/employment in coastal industry		
Social conditions and cultural traditions	% population with portable water		Change in user conflict
	Cultural stability/integrity		
Development pressure/capital construction		% of altered coastal land	Cost of coastal flooding/hazards and savings provided by coastal habitat
		% of impermeable surface in coastal zone	Dredging costs driven by sediment contamination
		Coastal fill acres/year	
Habitat change/ecological value		Service value of coastal habitat	Social costs of invasive species
		Value of habitat driven manufactured products	Service value changes from habitat alteration
			Changes to non-use values of coastal habitat
Contaminant introduction		% of population with wastewater treatment	% of coastal harvesting areas under environmental restrictions
		Fertilizer use in coastal watershed	
		Industrial inputs of POPs/metals	
Resource extraction activities		Oil spills from extraction/transportation	Seafood value changes from seafood risk/habitat alteration
		Commercial fishery landings	
		Seafood consumption patterns	
Human uses/activities		Coastal aquaculture	Marine-vectored disease
		Beach attendance	Beach closing costs

A3.7 Environmental Performance Index (Yale University, 2014)

Concept	Operationalized variable(s)
Health impacts	Child mortality
Air quality	Percentage of population using solid fuel
	Air pollution: Average exposure to PM2.5
	Air pollution: PM2.5 exceedance
Water and sanitation	Access to improved drinking water sources
	Access to an improved source of sanitation

A3.8 F'ANP social vulnerability indicators (Zebardast, 2013)

Concept	Operationalized variable(s)
Housing deprivation	Percent of illiterate population
	Percent of housing units less than 50m^2 in area
	Households per housing unit
	Percent of housing units with telephone
	Percent of housing units with kitchen
	Percent of housing units with bathroom
	Housing units built with non-durable materials
Unemployment	Percent of unemployed population
	Percent men unemployed
	Percent females participating in labour force
	Percent population participating in labour force
Dependent population	Percent of female-headed households
	Percent of population over 65 years old
	Percent of population under 6 years old
	Percent of women who are divorced or widowed
Less Development	Percent of rural population
	Percent employed in agriculture
	Hospital beds per 100,000 population
	Specialist physician per 100,000 population
Income deprivation	Percent simple labourer to total employed
	Percent of population with disability
	IKC social security recipients per 100,000 population
	Permanent social security recipients per 100,000 population
Females and migration	Percent of females
	Percent of population who are migrants
Health and infrastructure deprivation	General practitioner physician per 100,000 population
	Dentist per 100,000 population

A3.9 Human Development Index (United Nations Development Programme, 2014a)

Concept	Operationalized variable(s)
Longevity	Life expectancy at birth
Education	Mean years of schooling
	Expected years of schooling
Economic productivity	Gross national income (GNI) per capita

A3.10 Index of Social Vulnerability to Climate Change for Africa (Vincent, 2004)

Concept	Operationalized variable(s)
Economic well-being and stability	Standard of living/poverty (population below income poverty line)
	Change in % urban population
Demographic structure	Dependent population (population under 15 and over 65 as % of total
	Proportion of the working population with HIV/AIDS (Adults aged 15-49 living with HIV/AIDS
Institutional stability and strength of public infrastructure	Health expenditure as a proportion of GDP
	Telephones (number of mainland telephone lines per 1,000 population)
	Corruption (composite index using data from 15 sources from 9 institutions and perceptions of well-informed people)
Global interconnectivity	Trade balance (Net trade in goods and services)
Natural resource dependence	Rural population (% of rural population)

A3.11 Livelihood Vulnerability Index (Hahn et al., 2009)

Concept	Operationalized variable(s)
Socio-demographic	Dependency ratio (ratio of the population under 15 and over 65 years of age to the population between 19 and 64 years of age)
	Percent of female-headed households
	Percent of households where head of household has not attended school
	Percent of households with orphans
Livelihood	Percent of households with family member working in a different community (percentage of households that report at least 1 family member who works outside of the community for their primary work activity)
	Percent of households dependent solely on agriculture as a source of income
	Average Agricultural Livelihood Diversification Index
Health	Average time to health facility (in minutes)
	Percent of households with family member with chronic illness
	Percent of households where a family member had to miss work or school in the last 2 weeks due to illness
	Average Malaria Exposure Prevention Index
Social Networks	Average receive:give ratio (ratio of (the number of types of help received by a household in the past month +1) to (the number of types of help given by a household to someone else in the past month +1)
	Average borrow:lend money ratio (ratio of a household borrowing money in the past month to a household lending money in the last month)
	Percent of households that have not gone to their local government for assistance in the past 12 months.
Food	Percent of households dependent on family farm for food
	Average number of months households struggle to find food
	Average Crop Diversity Index
	Percent of households that do not save crops
	Percent of households that do not save seeds
Water	Percent of households reporting water conflicts
	Percent of households that utilize a natural water source
	Average time to water source (in minutes)
	Percent of households that do not have a consistent water supply
	Inverse of the average number of litres of water stored per household
Natural disasters and climate variability	Average number of flood, drought, and cyclone events in the past 6 years
	Percent of households that did not receive a warning about the pending natural disasters

	Percent of households with an injury of death as a result of the most severe natural disaster in the past 6 years
	Mean standard deviation of the daily average maximum temperature by month
	Mean standard deviation of the daily average minimum temperature by month
	Mean standard deviation of average precipitation by month

A3.12 MOVE (Birkmann et al., 2013)

Concept	Operationalized variable(s)
Floods (social dimensions of vulnerability):	
Exposed people	Number of people who are living in flood-prone areas
Ability to evacuate	Percentage of people who are able to evacuate themselves and others without external help (estimated based on age structure per household and information about invalid people)
Experience with floods	Percentage of people who have experience with floods (estimated based on the duration of residence of a specific household in flood-exposed area)
Insurance regarding damages due to natural hazards (floods)	Percentage of household with insurance against damage due to natural hazards
Flood protection agency	Qualitative information about the performance of the early warning system through expert interviews
Earthquake:	
Spectral acceleration and spectral displacement of more than 2,000 stochastic seismic scenarios affecting the city	Probabilistic intensity measure of the seismic demand to each exposed building, according to its period of vibration
Exposed buildings	Inventory and taxonomy of buildings of the city and distribution by district and other spatial units of analysis (building characteristics including age, construction materials, height/number of stories, type of structure, etc. for typology classification; property value)
Exposed people	Number of people living and working in the buildings of the city (average occupation during day/nights depending on building use (residential, office, commercial, industrial, etc.)
Expected economic loss: pure premium or average annual loss	Potential building damage (economic loss) expressed as a percentage of the property value
Expected human losses: premiums or expected casualties, injuries, homeless, and jobless	Potential effects on population (human losses) expressed as a percentage of the people occupation (human vulnerability functions to related the building damage with the potential casualties, injuries, homeless, jobless in the buildings according to the building occupation and typology)
Social dimension/Economic dimension:	
Financial deprivation	Percentage of the total area corresponding to poor neighbourhoods)
Healthcare access (	Number of deaths each 10,000 inhabitants
Social fragmentation and degradation	Number of crimes each 100,000 inhabitants
Social disparity	Inequality (index 0-100)
	Long-term unemployment (index 0-100)
	Poverty (index 0-100)
Overcrowding, tenement housing	Inhabitants per square kilometre of built area
Lack of resilience (institutional dimension, social dimension):	
Preparedness, capacity to cope	Number of hospital beds each 1,000 inhabitants
	Health human resources each 1,000 inhabitants
	Rescue and firemen manpower each 10,000 inhabitants
	Emergency planning (preparedness and emergency response capacity) - Benchmark index using three levels: 0-1-2
Capacity to cope and recover	Percentage of available public space of the total area
	Development level (quality of life, welfare, economic health, urban planning and governance) - Benchmark index using four levels: 1-2-3-4

A3.13 Multidimensional Poverty Index (United Nations Development Programme, 2014c)

Concept	Operational variable(s)
Education	School attendance for school-age children
	School attainment for household members
Health	Child mortality
	Nutrition level
Living standards	Access to electricity
	Access to improved drinking water sources
	Access to improved sanitation
	Uses solid fuel for cooking and heating
	Has a finished floor
	Has assets that allow access to information (radio, TV, telephone)
	Has assets that support mobility (bike, motorbike, car, truck, animal cart, motorboat)
	Has assets that support livelihood (refrigerator, own agricultural land, own livestock)

A3.14 NZ Deprivation Index (Atkinson et al., 2014)

Concept	Operationalized variable(s)
Socioeconomic	People aged <65 with no access to the Internet at home
	People aged 18-64 receiving a means tested benefit
	People living in households with equivalised income below an income threshold
	People aged 18-64 unemployed
	People aged 18-64 without any qualifications
	People not living in own home
	People aged <65 living in a single parent family
	People living in households below an equivalised bedroom occupancy threshold
	People with no access to a car
	People with no access to any phone at home

A3.15 NZ Neighbourhood Fragmentation Index (Ivory et al., 2012)

Concept	Operationalized variable(s)
Shared norms and values	Fewer school-aged children
	More recent immigrants (<1 year)
	More non-NZ language speakers
Place attachment	Less home ownership
	Less residential stability
	More single-person households
	Fewer married adults
	More nonfamily households
	(More income inequality)
Social resources	Fewer long-term residents (>15 years)
	(Fewer at-home parents)
	(Fewer caregivers)
	(Fewer pensions)
( ): not to be found to be internally significant	

A3.16 Predictive indicators of vulnerability (Adger et al., 2004)

Concept	Operationalized variable(s)
Health status	Population with access to sanitation
	Maternal mortality
	Calorie intake
	Life expectancy at birth
Governance	Voice and accountability
	Civic liberties
	Political rights
Education	Literacy rate, 15-24 year olds
	Literacy rate, over 15 years
	Literacy ratio (female to male)

A3.17 Prevalent Vulnerability Index (Cardona, 2005)

Concept	Operationalized variable(s)
Exposure and Susceptibility	Population growth, average annual rate
	Urban growth, average annual rate
	Population density
	Poverty - population living on less than US$1 per day
	Capital stock in millions US dollar per 1000 km^2
	Imports and exports of goods and services as a percent of GDP
	Gross domestic fixed investment as a percent of GDP
	Arable land and permanent crops as a percent of land area
Socioeconomic Fragility	Human Poverty Index
	Dependents as a proportion of the working age population
	Inequality as measured by the Gini co-efficient
	Unemployment as percent of the total labour force
	Percent annual increase in food prices
	Share of agriculture in total GDP growth (annual percent)
	Debt service burden as a percent of GDP
	Soil degradation resulting from human activities
Lack of resilience	Human development index (inverse)
	Gender-related Development Index (inverse)
	Social expenditures on pensions, health and education as a percent of GDP (inverse)
	Governance Index (Kaufmann) (inverse)
	Infrastructure and housing insurance as a percent of GDP (inverse)
	Television sets per 1000 people (inverse)
	Hospital beds per 1000 people (inverse)
	Environmental Sustainability Index, ESI (Inverse)

A3.18 Resilience Index New Zealand (Pearson et al., 2013)

Concept	Operationalized variable(s)
Culture	*Marae* travel time, mean
Community participation	Percent volunteerism, mean
	Percent childcare, mean
	Percent any service, mean
Rurality	Urban-rural status, mean

	Main urban area, percent
	Independent urban area, percent
	Satellite urban area, percent
	Rural area with high urban influence, percent
	Rural area with moderate urban influence, percent
	Rural area with low urban influence, percent
	High rural/remote area, percent
	Population density, in thousands
Cohesion	Social fragmentation index, mean
	Percent live in area (intervals: 0 years, 1-4 years, 5-9 years, 10-14 years, 15-29 years, and 30+ years)
	Percent territorial land authority (TLA) population lost or gain in 10 years, mean

A3.19 Social Flood Vulnerability Index (SFVI) (Tapsell et al., 2002)

Concept	Operationalized variable(s)
Social	Elderly (aged 75+)
	Lone/single parents
	Pre-existing health problems (Long-term illness)
Financial deprivation	Non-homeowners
	Unemployed
	Non-car owners
	Overcrowding (households with more than one person per room

A3.20 Social Vulnerability Index (Agency for Toxic Substances and Disease Registry, 2014)

Concept	Operationalized variable(s)
Socioeconomic	Proportion of persons below poverty estimate
	Proportion of civilian (age 16+) unemployed estimate
	Per capita income estimate
	Proportion of persons (age 25+) with no high school diploma estimate
Household composition	Proportion of persons aged 65 and older
	Proportion of persons aged 17 and younger
	Proportion of single parent household with children under 18
Minority status/Language	Proportion of minority (all persons except white, non-Hispanic)
	Proportion of persons (age 5+) who speak English "less than well" estimate
Housing/Transportation	Proportion of housing in structures with 10 or more units
	Proportion of mobile homes estimate
	Proportion of households with more people than rooms estimate
	Proportion of households with no vehicle available estimate
	Proportion of persons in institutionalized group quarters

A3.21 Social Vulnerability Index (Rygel et al., 2006)

Concept	Operationalized variable(s)
Social	Poverty
	Immigrants
	Old age/disabilities

A3.22 Social Vulnerability Index (Walker et al., 2014)

Concept	Operationalized variable(s)
Social	Average income
	Housing ownership
	Percentage of single-parent families
	Percentage of no high school completion
	Unemployment rate
	Percentage of dependent population
	Percentage of seniors living alone
	Percentage of foreign language only
	Percentage of recent movers (within the past year)
Systemic	Driving time to hospitals
	Walking time to hospitals
	Number of road lanes per kilometre
Physical	Liquefaction rating
	Soil amplification rating

A3.23 Social vulnerability indicators (Dwyer et al., 2004)

Concept	Operationalized variable(s)
Individual	Age
	Income (weekly individual income)
	Residence type
	Tenure type (The distribution of household types by average weekly household income)
	Employment (Employment by age)
	English skills (Proficiency in English by age)
	Household type
	Disability (Users of all Commonwealth-State Disability Agreement)
	House insurance
	Health insurance (Private hospital insurance)
	Debt and savings
	Car (Number of motor vehicles by household type)
	Gender
Individual impacts:	Injuries
	Resident damage
Community	Reciprocity
	Sense of efficacy
	Cooperation
	Social participation
	Civic participation
	Community support
	Network size
	Frequency and mode of communication
	Emotional support
	Integration into the community
	Common action
	Bonding
	Bridging

	Linking
	Isolation
Access to services	Major cities
	Inner regional
	Outer regional
	Remote
	Very remote
Organisational/institutional	Local government responsibility
	State compensation/assistance agreement
	Previous NDRA funding
	NDRMSP funding
	Charity/fundraising cause

A3.24 Social Vulnerability Index (SoVI) ("Changes and improvements in the SoVI® formulation for 2006-10," n.d.; Cutter et al., 2003)

Concept	Operationalized variable(s)
Race (black) and class (poverty)	Percent poverty
	Percent of housing units with no car
	Percent female headed households
	Percent renters
	Median gross rent
	Percent civilian unemployment
	Percent employment in service industry
	Percent employment in extractive industries
	Percent with less than 12th grade education
	Percent of children living in married couple families
	Percent mobile homes
	Percent unoccupied housing units
Extreme wealth	Median house value
	Percent of householders earning greater than USD$200,000 annually
	Median rent
	Per capital income
	Percent Asian
Age (elderly)	Percent of households receiving social security
	Percent of population under 5 years or 65 and over
	Median age
	People per unit
Ethnicity	Percent Hispanic
	Percent Native American
	Percent speaking English as a second language with limited English proficiency
Gender (female)	Percent female
	Percent female participation in labour force
Care dependency, medical disability, and health care access	Percent of population living in nursing and skilled-nursing facilities
	Hospitals per capita
	Percent of population without health insurance (County level only)
	Percent of population with disability (in SoVI 2005-2009)

A3.25 Social Vulnerability Index (SoVI) – China (Lixin et al, 2014)

Concept	Operationalized variable(s)
Gender	Female population
Disabled	Disabled people
Age	Less than or equal to 14 years old
	Greater than or equal to 65 years old
Family structure	Divorce rate
Minority	Minority population
Education	People graduated from college
	Illiterate population
Medical service	Certified (assistant) physicians per 10,000 persons
Socioeconomic status	GDP per capita
	Per capita disposable income
Employment	Unemployment population

A3.26 Urban indicators (Cardona, 2005)

Concept	Operationalized variable(s)
Physical risk	Damaged area
	Number of decease
	Number of injured
	Ruptures in water mains
	Ruptures in gas network
	Fallen lengths on HT power lines
	Telephone exchanges affected
	Electricity substations affected
Impact factor	Slums-squatter neighbourhoods
	Mortality rate
	Delinquency rate
	Social disparity index
	Population density
	Hospital beds
	Health human resources
	Public space/shelter facilities
	Rescue and firemen manpower
	Development level
	Preparedness/emergency planning

A3.27 Urban risk evaluation (Carreño et al., 2007)

Concept	Operationalized variable(s)
Slums-squatter neighbourhoods	Slum-squatter neighbourhoods area/Total area
Mortality rate	Number of deaths each 10,000 inhabitants
Delinquency rate	Number of crimes each 100,000 inhabitants
Social disparity index	Index between 0 and 1
Population density	Inhabitants/Km2 of build area
Hospital beds	Number of hospital beds each 1,000 inhabitants
Health human resources	Health human resources each 1,000 inhabitants
Public space	Public space area/Total area

Rescue and firemen manpower	Rescue and firemen manpower each 10,000 inhabitants
Development level	Qualification between 1 and 4
Risk management index	Index between 0 and 1

A3.28 Vulnerability and capacity assessment (IFRC, 2007)

Concept	Operationalized variable(s)
Natural (Identification of)	Land
	water supply
	forest resources
	Fishing resources
	Wild plants
	etc.
Physical	Tools
	Equipment
	Roads that are useful
	Transport
	Electricity
	Sewage
	Water taps or wells
Financial	Savings (including jewellery, if relevant)
	Access to credits
	Debts
Human	Education
	Training
	Qualifications
	Skills
	Etc.
Social	Participation in community groups
	Connections with kin in other villages or towns
	Linkages with a religious institution
	Membership of a political party

A3.29 The vulnerability sourcebook (Fritzsche et al., 2014)

Concept	Operationalized variable(s)
Climatic stimuli	Number of nights with T(min) above 25C
	Number of extreme rainfall events
	Number of days with T(max) below 0C
	Percentage of flooded area (100 year event)
	Frequency of (experienced) storm events
Bio-physical characteristics	Land cover data
	Crop type
	Irrigation system
Socio-economic characteristics	Population density
	Number of people in 100 year flood zone
Loss indicator	Loss in agricultural production
	Potential flood damage
Potential impact indicator	Potential storm impact
Adaptive capacity (socio-economic characteristics)	Level of education
	Income
	GINI Index
	Access to efficient irrigation technology
	Access to health facilities
Adaptive capacity (policy indicators)	Change in land use planning policies
	Governance indicator
Gender-sensitive indicators	Adult literacy rate: female
	Gender Inequality Index
	Gender-related Development Index
	Gross school enrolment ratio (primary and secondary): female
	Ratio of girls to boys in primary and secondary education
	Ratio of female to male tertiary enrolment
	Progression of females to secondary school
	Infant mortality
	Maternal mortality ratio
	Percent of female-headed households
	Percent of households with family member with chronic illness
	Percent of households with family member working in a different community
	Percent of households with orphans
	Civic organisations and associations active in the area (opt.: concerned with gender issues)
	Share of issued land titles held women
	Share of women in wage employment in the non-agricultural sector
	Women's share of total labour force

Appendix 6 Measuring community resilience: Translation of BRIC indicators to the New Zealand context

Measuring community resilience: Translation of BRIC indicators to the New Zealand context

A. H. Kwok

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Abstract

As New Zealand seeks to develop tools for assessing resilience as part of its national resilience strategy, this report illustrates how a direct translation of resilience indictors and indicator variables from the Benchmarking Resilience Indicators for Communities (BRIC) – a U.S.-based resilience assessment tool – for New Zealand presents both challenges and opportunities. Key challenges include the absence of publicly available datasets at different geographic scales and the applicability of indicator concepts that reflect New Zealand's institutional, physical, socioeconomic, and natural environments. However, the underlying theoretical framework – disaster resilience of place (DROP) – of BRIC provides an empirically sound basis for the development of New Zealand-specific indicators that can address the need for benchmarking and tracking resilience levels and help inform disaster risk reduction policies. The development of resilience indicators should also consider capturing the structural and cognitive dimensions of resilience; understanding how influences at the macro, meso, and micro levels may result in varying degrees of resilience between communities within the same geographic region; accounting for the interactions between hazard risks and consequences, vulnerabilities, and resilience capacities; and identifying potential indicators and new assessment methods through the involvement of stakeholders at various levels (e.g., national, regional, city, suburb).

Keywords

Resilience, indicators, New Zealand, BRIC

1.0 Introduction

The policy and disaster management sectors have recognised the importance of baselining and tracking progress on resilience-building investments as building disaster resilience has become increasingly integrated into national, regional, and local disaster management policies (Committee on Increasing National Resilience to Hazards and Disasters & Committee on Science Engineering and Public Policy, 2012). Although the discourse on disaster resilience has proliferated, the development of resilience measurements is still a nascent science due to the complex interactions of resilience drivers, processes, characteristics, and outcomes. As New Zealand progresses in the development of a national strategy on disaster resilience (Ministry of Civil Defence and Emergency Management, 2016a) and in developing tools for evaluating resilience (Ministry of Business Innovation and Employment, 2018), there is an apparent lack of a holistic benchmarking of resilience levels across the country, even though a wide array of resilience measurement tools have recently been developed to operationalise and evaluate the concept of resilience (Cutter, 2016; Ostadtaghizadeh et al., 2015). To fill this knowledge gap, this report primarily seeks to address the question of whether a US-based resilience measurement index can be adapted for use within the New Zealand context. Secondarily, it identifies measurement data gaps that are needed to reflect community resilience. To meet these two research objectives, this report presents the author's effort to translate one of the existing resilience measurement indices – the Benchmarking Resilience Indicators for Communities (BRIC) – for the New Zealand context (Cutter et al., 2014, 2010).

Because this report serves to provide a succinct primer for understanding the complexity of assessing disaster resilience, it first provides a very brief background on how disaster resilience is framed within the literature and discussion on New Zealand's disaster risk reduction policies on resilience. Readers of this report are encouraged to refer to the cited works. After setting the context, an overview of the BRIC indicators and the process of translating these indicators for use within New Zealand are described. A discussion on the challenges of translating BRIC indicators for measuring community resilience, as well as opportunities for moving forward in assessing resilience of New Zealand communities, rounds out the report.

2.0 Framing disaster resilience – a brief background

Since Holling (1973) first explored the concept of *resilience* in ecological systems, the term has subsequently been applied to various research disciplines, from psychology to sustainable development to climate change science to disaster resilience research. Because of disparate epistemological perspectives and the multidimensionality of resilience, the definition and operationalisation of the concept have been widely debated but have yet to result in any universal agreements on how best to assess it (Ainuddin & Routray, 2012; Cutter et al., 2014, 2008a). Generally, disaster resilience can be conceptualised into two perspectives: capital-based approach and adaptive capacities.

The capital-based approach to conceptualising disaster resilience can be attributed to the community capitals framework that was developed by Flora and Flora (2008). Disaster resilience is framed as comprising different forms of community capitals (i.e., resources): social, cultural, economic, physical, human, political and natural (Mayunga, 2009; National Institute of Standards and Technology, 2015; L. A. Ritchie & Gill, 2011). Disaster resilience focuses on the available resources for use by communities before, during and after a disaster. It also deals with the ability of responders and community stakeholders to mobilise such resources (Ritchie & Gill, 2011). The conceptualisation of resilience as different forms of community capitals, therefore, renders resilience as a static phenomenon. Resilience assessments based on this conceptual framework rely on indicators and variables that represent the different types of capitals. Measurements for certain capitals are methodologically easier for some (e.g., physical infrastructure) than others (social and cultural resources). Although indicators vary depending on assessments, they rarely address the dynamic aspects of resilience, such as the potential conflicts in how these capitals are valued and prioritised by different stakeholder groups at different phases of a disaster (Ritchie & Gill, 2011).

An alternate approach to conceptualising resilience is framing it as an adaptive capacity, which is seen as a dynamic process (Becker et al., 2013; Berkes, 2007; Klein et al., 2003; Norris et al., 2008; Paton, 2006a). Adaptive capacity, simply put, is the ability to adapt (Engle, 2011). It comprises the qualities of learning and adjustments that occur before, during, and after a disturbance (Engle, 2011). In Table 1, Folke et al. (2003) describe the various dimensions of adaptive capacity.

Table 1. *Dimensions of adaptive capacity*

Dimensions
• Learn to live with uncertainty, change
• Nurture diversity for reorganisation and renewal
• Combine different types of knowledge for learning
• Create opportunities for self-organisation

Note. From "Synthesis: Building resilience and adaptive capacity in socio-ecological systems", by C. Folke, J. Colding, and F. Berkes, 2003, *Navigating Social-Ecological Systems: Building Resilience for Complexity and Change*, 2002, p. 355.

When a hazard event occurs, people react and adapt to changes in their altered environment. They also anticipate future disturbances and take proactive actions to mitigate future consequences (Engle, 2011). The examination of this iterative process of reactive and anticipatory adaptation has informed a number of resilience frameworks. These include the resilience properties by Bruneau and his colleagues (2003); the resistance-persistence-transformation framework by Matyas and Pelling (2012); the disaster resilience of place (DROP) framework (Cutter et al., 2008a); the community resilience framework by Norris et al. (2008); and the community resilience model by Paton (2013). Resilience assessments based on these frameworks are varied and evolving due to the dynamic nature of the concept and emerging understanding of the interactions between factors and influences that shape the ability and efficacy of

people and groups to adapt. The implications on resilience measurements based on the dynamic conceptualisation of the concept include identifying indicators that reflect the adaptiveness of people and groups.

Although resilience can be seen as a static resource or as a dynamic process, there is a general consensus that communities need to enhance their existing resources, skills, knowledge, and capacities to prepare for, response to, recover from and adapt to actual and potential emergencies and disasters (Cutter et al., 2014; Mayunga, 2007).

3.0 Nexus of disaster resilience and New Zealand's disaster risk reduction policies

The call for measuring community disaster resilience is explicitly integrated into New Zealand's national and local policies as well as into research funding mechanisms. The National Civil Defence Emergency Management Strategy has adopted the vision of a "Resilient New Zealand – Communities Understanding and Managing their Hazards" as part of the Civil Defence and Emergency Management Act (CDEM) 2002 (MCDEM, 2008, p. 6). The strategy emphasised the importance of understanding the perspectives, expectations, and needs of communities in hazard management (MCDEM, 2008, p. 6). A capability assessment conducted as part of the strategy has identified the need for measuring and tracking community resilience (MCDEM, 2012). Furthermore, the recently launched National Science Challenges – a New Zealand's research funding platform – call for benchmarking resilience levels across the country as one of its deliverables (Ministry of Business Innovation and Employment, 2018). The government's research funding priorities demonstrate its recognition on the importance of understanding and assessing natural hazards facing communities across the country (Ministry of Business Innovation and Employment, 2016).

At the local level, the implementation of national resilience policies and priorities into community-based actions has already taken place as a result of past disasters. Regional civil defence and emergency management (CDEM) groups have begun to strengthen communities' capabilities to mitigate and respond to major natural hazard events. For instance, the Wellington Region Emergency Management Office (WREMO), which administers emergency management for the region, has developed a community resilience strategy that outlines its approach to interfacing with local communities to baseline resilience levels; fostering social connectedness of people, organisations, and communities; and enhancing their ability to prepare for, respond to, and recover from disasters (Wellington Region Emergency Management Office, 2012, 2013). In carrying out its strategic goals, WREMO has engaged with several communities in the Wellington region to develop community-based response plans (Paul, 2015; WREMO, 2012).

Because CDEM's disaster resilience interventions occur at the local levels (i.e., regional and sub-regional), assessment tools that measure resilience at the suburb, territorial authority, and regional levels would prove relevant to stakeholders that work at each of these levels. Hence, adapting existing resilience measurement tools that can be applied to the New Zealand context and at multiple geographic scales could be beneficial. Not only would a cross-scalar benchmarking tool be useful for local stakeholders, but it could also paint a broad picture that could help shape national policies.

4.0 Why BRIC? Anatomy and maturity of existing resilience assessments

A number of reviews have been conducted that evaluate existing resilience measurements and their underlying conceptual frameworks. Therefore, this report will summarise key findings of those reviews.

First, there is an increasing number of resilience assessments being developed. A review by Cutter (2016) has identified 27 assessment tools. These can be categorised into indices, scorecards, and tools, as well as be differentiated into the types of data being used and into assessment properties (Cutter, 2016). A description of each of these assessment types and differentiating properties is presented in Table 2.

Table 2. *Types and distinguishing properties of disaster resilience assessment*

Assessment type	**Data type**	**Assessment property for indices, scorecards, and tools**
Indices: An aggregation or a composite of individual indicators, which are measurable variables that represent certain resilience characteristics.	Quantitative	**Focus**: An assessment of specific assets or a whole community and its attributes. **Spatial**: An assessment's unit of analysis, which ranges from individual communities to nations. Some assessments have no spatial unit if they measure a single dimension of resilience. **Method**: Top-down approach utilises quantitative datasets from existing national and/or international datasets. Bottom-up approach collects data through qualitative or quantitative, self-reported information. **Domain**: Characteristics are quantities of some attribute that are present in a system/community, while capacities reflect the performance or quality embedded within a system/community.
Scorecards: A checklist of items or actions used to evaluate performance or progress. The selection of items is converted into a score, either as a value (e.g., 1-10) or a descriptor (e.g., excellent to poor).	Qualitative, which could be converted into quantitative datasets	
Tools – toolkits or models: Models are mathematical or matrix representation of processes to explain the relationships of different societal elements, while toolkits provide a ready-made guidance for assessing community resilience based on specific procedures, survey instruments and/or data for use in compiling resilience indices or scorecards.	Quantitative/ qualitative	

Note. From "The landscape of disaster resilience indicators in the USA" by S.L. Cutter, 2016, *Natural Hazards, 80*(2), p. 741-758.

One of the indices that is the focus of this report is the Baseline Resilience Indicators for Communities (BRIC). The BRIC assessment tool is an index comprising of individual indicators that reflect the inherent resilience of different societal dimensions (social, economic, community capitals, institutional, housing/infrastructural, and environmental) (Cutter et al., 2014). It is grounded on the disaster resilience of place (DROP) theoretical framework and is developed to measure inherent resilience of places (Cutter et al., 2010). The index was tested within the U.S. Federal Emergency Management Agency's (FEMA) Region IV, encompassing the south-eastern states (Cutter et al., 2010) and nationally (Cutter et al., 2014).

A report produced by Stevenson et al. (2015) on assessing and monitoring resilience has proposed a maturity scale for many of the existing resilience tools. The maturity scale, which rates each tool based on the level of robustness – in terms of underlying theoretical frameworks, operational validity, and applicability for the development of resilience interventions and policies – from level 1 (low maturity in which an assessment is untested and not validated) to level 5 (high maturity in which an assessment has a robust underlying theoretical framework and is validated). Based on the report's evaluation of assessment maturity, the BRIC assessment has a high level of maturity (i.e., maturity level at 4.5) and is rated highly for it's potential to inform policies and intervention strategies for New Zealand.

5.0 Overview of BRIC indicators of resilience

The latest version of the BRIC assessment consists of 49 indicators reflecting the capitals within each of the six societal resilience dimensions – social resilience, community capitals, economic resilience, institutional resilience, housing/infrastructural resilience, and environmental resilience (Cutter et al., 2014). Social resilience indicators reflect the demographic qualities of a community. Relating to the social resilience indicators are community capitals, which measure the propensity of people to assist others. These indicators assess the level of community engagement and the potential for local social networks. Indicators for economic resilience provide an overview of a community's economic profile, which includes economic vitality, diversity, and equality in compensation. The housing/infrastructural resilience indicators assess the structural integrity of the housing stock and physical capacities that can meet the challenges (e.g., evacuation, housing, schooling, medical care) presented by a hazard event. The institutional resilience indicators relate to the programmes, policies, and governance of disaster resilience. The last category – environmental resilience indicators – captures the qualities of the environment to absorb the impacts of natural hazards. The BRIC indicators are listed in Table 3.

Table 3. *BRIC's resilience indicators and variables*

Item	Indicator	Variable
Social resilience		
1	Educational attainment equality	Negative difference between % of population with college education and % with less than high school education
2	Pre-retirement age	% population below 65 years of age
3	Transportation	% households with at least one vehicle
4	Communication capacity	% households with telephone service available
5	English language competency	% population proficient English speakers
6	Food provisioning capacity	Food security rate
7	Health insurance	% population under age 65 with health insurance
8	Non-special needs	% population without sensory, physical, or mental disability
9	Mental health support	Psychosocial support facilities per 10,000 persons
10	Physician access	Physicians per 10,000 persons
Community capitals		
11	Place attachment-not recent immigrants	% population not foreign-born persons who came to US within previous five years
12	Place attachment-native born residents	% population born in state of current residence
13	Political engagement	% voting age population participating in presidential election
14	Social capital-civic organisations	Number of civic organizations per 10,000 population
15	Social capital-advocacy	Number of social advocacy organizations per 10,000 population
16	Social capital-religious organisations	Persons affiliated with a religious organisation per 10,000 persons
17	Social capital-disaster volunteerism	Red Cross volunteers per 10,000 persons
18	Citizen disaster preparedness and response skills	Red Cross training workshop participants per 10,000 persons
Economic resilience		
19	Homeownership	% owner-occupied housing units
20	Employment rate	% labour force employed
21	Gender income equality	Negative absolute difference between male and female median income
22	Race/ethnicity income equality	Negative Gini coefficient

22	Non-dependence on primary/tourism sectors	% employees not in farming, fishing, forestry, extractive industry, or tourism
23	Business size	Ratio of large to small businesses
24	Large retail-regional//national geographic distribution	Large retail stores per 10,000 persons
25	Federal employment	% labour force employed by federal government
Institutional resilience		
26	Mitigation spending	Ten year average per capita spending for mitigation projects
27	Flood insurance coverage	% housing units covered by National Flood Insurance Program
28	Jurisdictional coordination	Governments and special districts per 10,000 persons
29	Disaster aid experience	Presidential disaster declarations divided by number of loss-causing hazard events from 2000-2009
30	Local disaster training	% population in communities with Citizen Corps program
31	Performance regimes-state capital	Proximity of county seat to state capital
32	Performance regimes-nearest metro area	Proximity of county seat to nearest county seat with a Metropolitan Statistical Area
33	Population stability	Population change over previous five-year period
34	Nuclear plant accident planning	% population within 10 miles of nuclear power plant
35	Crop insurance coverage	Crop insurance policies per square mile
Housing/infrastructural resilience		
36	Sturdier housing types	% housing units not mobile homes
37	Housing stock construction quality	% housing units build prior to 1970 or after 2000
38	Temporary shelter availability	Hotels/motels per 10,000 persons
39	Temporary housing availability	% vacant units that are for rent
40	School restoration potential	Public schools per 10,000 persons
41	Medical care capacity	Hospital beds per 10,000 persons
42	Evacuation routes	Major road egress points per 10,000 persons
43	Industrial re-supply potential	Rail miles per square mile
44	High speed internet infrastructure	% population with access to broadband internet service
Environmental resilience		
45	Local food suppliers	Farms marketing products through Community Supported Agriculture per 10,000 persons
46	Natural flood buffers	% land in wetlands
47	Efficient energy use	Megawatt hours per energy consumer
48	Pervious surfaces	Average percent perviousness
49	Efficient water use	Inverted water supply stress index

Note. From "The geographies of community disaster resilience", by S.L. Cutter, K. Ash, C. Emrich, 2014, *Global Environmental Change, 29*, p. 69-70.

6.0 Translation of BRIC indicators to the New Zealand context

6.1 Methods

The first step in the translation of BRIC indicators involved a stocktake of existing publicly available datasets in New Zealand. In order to allow for replicability of resilience assessments across different areas within the country, only publicly available data sources were included in the review. The second step was to identify comparable datasets that reflect the underlying concepts and intention of each BRIC indicator. This step also evaluates the spatial scale, as defined by Statistics New Zealand and other legislations, at which the datasets are available. A summary of the geographic units is described in Table 4. Finally, where there is a lack of available datasets that correspond to the BRIC indicators, substitution or modification of potential indicators and indicator variables was carried out.

Table 4. *Geographical units of datasets in New Zealand*

Geographical scale	Description
Meshblock	The smallest geographical unit reported by Statistics New Zealand. Each meshblock varies in size, from part of a city block to a large area of rural land to coasts and inlets. It forms the building block for statistical sampling, collection, and data output.
Area unit	A non-administrative area that is an aggregation of meshblocks. Its size is between meshblock and territorial authority.
Ward	An area that forms a district of territorial authority. As defined by the Local Electoral Act 2001, ward boundaries are defined at meshblock level but do not align to the boundaries of an area unit.
Territorial authority	An area that is defined under the Local Government Act 2002 as a city council or district council. It is defined at meshblock and area unit level.
Regional (council)	As defined at meshblock and area unit level, it contains complete territorial authorities.
National	An area that is defined at the country level.
DHB	District health board area, which is defined by the Ministry of Health.

Note. From https://www.stats.govt.nz/. Copyright (2016b) by Statistics New Zealand.

6.2 Results

The translated variables of BRIC indicators are presented in Table 5. As shown in the table, a number of indicators and indicator variables, including those pertaining to demographic and economic resilience, are directly applicable within the New Zealand context since data are available and exist at various geographic scales. However, many indicators and indicator variables require modifications due different datasets that are collected in New Zealand. Several indicators, especially those pertaining to institutional resilience, are not applicable within the New Zealand context due to different political and institutional regimes. Furthermore, there are fewer datasets available at the meshblock level than those at other geographic scales (e.g., territorial authority and regional council).

Table 5. *Translation of BRIC variables for the New Zealand context based on data availability*

Item	Resilience domain	Variable	Modification needed?	Source of data in New Zealand	Variable	Spatial scale of data availability							Notes/issues
						Mesh-block	Area Unit	Ward	Territ. Auth.	Region	Nat.	DHB	
Social resilience													
1	Educational attainment equality	Negative difference between % of population with college education and % with less than high school education	--	Census	Negative difference between % of population with tertiary education and % with less than high school education	X	X	X	X	X	X		
2	Pre-retirement age	% population below 65 years of age	--	Census	% population below 65 years of age	X	X	X	X	X	X		
3	Transportation	% households with at least one vehicle	--	Census	% households with at least one vehicle	X	X	X	X	X	X		
4	Communication capacity	% households with telephone service available	--	Census	% households with telephone service available	X	X	X	X	X	X		Census data also capture information on household's access to the internet
5	English language competency	% population proficient English speakers	X	Census	% population who speak English	X	X	X	X	X	X		Census data do not differentiate fluency levels
6	Food provisioning capacity	Food security rate	--	NZ Adult Nutrition Survey	Food security rate	--	--	--	--	--	X		Survey last conducted in 2008/2009
7	Health insurance	% population under age 65 with health insurance	X	Not applicable	Not applicable	--	--	--	--	--			NZ residents have access to primary health care; anyone who is legally in NZ (including tourists) is covered by the Accident Compensation Corporation
8	Non-special needs	% population without sensory, physical, or mental disability	X	NZ Disability Survey	% population without sensory, physical, or mental disability	--	--	--	--	X	X		Disability survey is a self-reported instrument
9	Mental health support	Psychosocial support facilities per 10,000 persons	X	Medical Council of NZ	Psychologists per 10,000 persons	--	--	--	X	X	X	X	Data based on DHB's geographic boundaries
10	Physician access	Physicians per 10,000 persons	X	Medical Council of NZ	Physicians per 10,000 persons	--	--	--	X	X	X	X	Data based on DHB's geographic boundaries
Community capital													
11	Place attachment-not recent immigrants	% population not foreign-born persons who came to US within previous five years	--	Census	% foreign-born population who arrived in New Zealand for more than five years	X	X	X	X	X	X		
12	Place attachment-native born residents	% population born in state of current residence	X	Census	% population born in New Zealand	X	X	X	X	X	X		NZ census captures place attachment nationally and at the individual level
13	Political engagement	% voting age population participating in presidential election	X	Department of Internal Affairs	% of voting age population participating in 2014 general election	--	--	X	X	X	X		Instead of presidential election, the use of parliamentary election is used
14	Social capital-civic organisations	Number of civic organizations per 10,000 population	X	Charities Register	Number of civic organizations per 10,000 population	--	--	--	X	X	X		Physical location may be different than postal address; organisations may have multiple functions
15	Social capital-advocacy	Number of social advocacy organizations per 10,000 population	X	Charities Register	Number of social advocacy organizations per 10,000 population	--	--	--	X	X	X		
16	Social capital-religious organisations	Persons affiliated with a religious organisation per 10,000 persons	X	Census	Persons affiliated with a religion per 10,000 persons	X	X	X	X	X	X		Religious beliefs not necessarily the same as affiliation with a religious organisation
17	Social capital-disaster volunteerism	Red Cross volunteers per 10,000 persons	--	NZ Red Cross	Red Cross volunteers per 10,000 persons	--	--	--	X	X	X		Not all NZ Red Cross volunteers are involved in disasters-related volunteerism
18	Citizen disaster preparedness and response skills	Red Cross training workshop participants per 10,000 persons	X	CDEM	CDEM training workshop participants per 10,000 persons	--	--	--	X	X	--		Selected CDEM groups (e.g., Wellington) offer training opportunities
Economic resilience													
19	Homeownership	% owner-occupied housing units	--	Census	% owner-occupied housing units	X	X	X	X	X	X		
20	Employment rate	% labour force employed	--	Census	% labour force employed	X	X	X	X	X	X		
21	Gender income equality	Negative absolute difference between male and female median income	--	Census	Negative absolute difference between male and female median income	X	X	X	X	X	X		
22	Race/ethnicity income equality	Negative Gini coefficient	--	Census	Negative Gini coefficient	X	X	X	X	X	X		

22	Non-dependence on primary/tourism sectors	% employees not in farming, fishing, forestry, extractive industry, or tourism	--	Census	% employees not in farming, fishing, forestry, extractive industry, or tourism	X	X	X	X	X	X		
23	Business size	Ratio of large to small businesses	--	MBIE	Ratio of large business (employing greater than 20 people); number of small businesses (employing fewer than 20)	--	--	--	X	X	X		
24	Large retail-regional//national geographic distribution	Large retail stores per 10,000 persons	--	http://www.indexnz.com/Top/Shopping/Retail-Chains; MBIE	Large retail stores per 10,000 persons	--	--	--	X	X	X		
25	Federal employment	% labour force employed by federal government	X	Census	% labour force in the following NZSCO99 major employment groups: legislators, administrators and managers; professionals; and technicians and associate professionals	X	X	X	X	X	X		NZ census data capture employment type by individuals, but do not differentiate whether they are employed in the government or private sector
Institutional resilience													
26	Mitigation spending	Ten year average per capita spending for mitigation projects	X	CDEM Resilience Fund	Five year average per capita spending for mitigation and capability building projects	--	--	--	--	X	--		
27	Flood insurance coverage	% housing units covered by National Flood Insurance Program	X	General Social Survey	% housing units with private insurance (house or content) that covers fire	--	--	--	--	X	X		Earthquake insurance (through EQC) is included when private insurance with fire coverage is purchased. An issue relates to homes that are under-insured.
28	Jurisdictional coordination	Governments and special districts per 10,000 persons	X	Not applicable	--	--	--	--	--	--	--		Each jurisdiction's disaster management activities are managed by respective regional CDEM group. Mutual aid between CDEM groups is exercised for both regional and national hazard events.
29	Disaster aid experience	Presidential disaster declarations divided by number of loss-causing hazard events from 2000-2009	X	CDEM groups	The number of CDEM responses at the incident to national level events between 2005-2015	--	--	--	X	X	X		
30	Local disaster training	% population in communities with Citizen Corps program	X	Not applicable	--	--	--	--	--	--	--		CDEM groups develop specific programmes for local communities.
31	Performance regimes-state capital	Proximity of county seat to state capital	X	Not applicable	--	--	--	--	--	--	--		Decision-making rests on respective CDEM group under the Ministry of Civil Defence.
32	Performance regimes-nearest metro area	Proximity of county seat to nearest county seat with a Metropolitan Statistical Area	X	Not applicable	--	--	--	--	--	--	--		This variable does not apply to the political system of New Zealand. CDEM groups/local councils oversee disaster management functions in partnership with other local agencies.
33	Population stability	Population change over previous five year period	--	Census	Population change over previous five year period	X	X	X	X	X	X		
34	Nuclear plant accident planning	% population within 10 miles of nuclear power plant	X	Not applicable	Not applicable	--	--	--	--	--	--		New Zealand is nuclear-free
35	Crop insurance coverage	Crop insurance policies per square mile	--	Not applicable	Not applicable	--	--	--	--	--	--		Farm policies in New Zealand are different than those in the U.S. (McLeman & Smit, 2006)
Housing/infrastructural resilience													
36	Sturdier housing types	% housing units not mobile homes	X	RiskScape	% of 'sound' residential buildings % of houses with secured foundations	X	X	X	X	X	X		
37	Housing stock construction quality	% housing units build prior to 1970 or after 2000	X	RiskScape	% of non-residential buildings built after 1976	X	X	X	X	X	X		
38	Temporary shelter availability	Hotels/motels per 10,000 persons	X	Accommodation Survey – Statistics NZ/MBIE	Hotels, motels, backpackers, and holiday parks per 10,000 persons	--	--	--	--	X	X		
39	Temporary housing availability	% vacant units that are for rent	X	Department of Building and Housing	% vacant units that are for rent	--	--	--	--	X	X		No existing database exist. Data can be derived using tenancy bond datasets (http://www.nzae.org.nz/wp-

													content/uploads/2012/08/Estimating-Rental-Vacancy-NZAE-conference.pdf)
				Housing NZ	% vacant Housing New Zealand (social housing) for rent	--	--	--	X	X	X		Social housing vacancy does not include units owned by local councils
40	School restoration potential	Public schools per 10,000 persons	X	Ministry of Education	Public and private schools per 10,000 persons	--	--	--	X	X	X		
41	Medical care capacity	Hospital beds per 10,000 persons	--	District Health Boards	Hospital beds per 10,000 persons	--	--	--	X	X	X		District Health Boards have different geographic boundaries.
42	Evacuation routes	Major road egress points per 10,000 persons	X	Land Information NZ	Distance to major road egress points	X	X	X	X	X	X		
43	Industrial re-supply potential	Rail miles per square mile	X	Ministry of Transport	Rail miles per square kilometres	--	--	--	--	X	X		
44	High speed internet infrastructure	% population with access to broadband internet service	X	Census	% population with access to internet service	X	X	X	X	X	X		NZ census data do not differentiate whether internet service is broadband or not
Environmental resilience													
45	Local food suppliers	Farms marketing products through Community Supported Agriculture per 10,000 persons	--	Not applicable	--	--	--	--	--	--	--		Farm policies in New Zealand different than those in the U.S. (e.g. NZ's lack of subsidies for farms) (McLeman & Smit, 2006)
46	Natural flood buffers	% land in wetlands	--	Statistics NZ/ LINZ/Landcare Research	% land in wetlands	--	--	--	--	X	X		
47	Efficient energy use	Megawatt hours per energy consumer	X	BRANZ – HEEP	Kilowatt hours per occupant per year	--	--	--	--	X	X		Only selected cities and regions are detailed. Otherwise, energy use is clustered between warm and cool weather regions.
48	Pervious surfaces	Average percent perviousness	--	Landcare Research	Average percent perviousness	--	--	--	X	X	--		Only selected cities and regions have data mapped
49	Efficient water use	Inverted water supply stress index	X	Statistics NZ	Water physical stock account	--	--	--	--	X	X		

7.0 Discussion

7.1 Challenges: Data availability and applicability

The translation of BRIC indicators to fit within the context of New Zealand presents several challenges. First, data availability is the biggest challenge. Data availability varies for different indicator variables. This is not surprising given the differences in the political and institutional realities between the U.S. and New Zealand. Because of such differences, many of the indictors and indicator variables need to be modified for the New Zealand context. Second, the geographic scales of available datasets are not consistent, with some datasets available at the smallest unit (i.e., meshblock), while others only at the national unit. As a multi-scalar resilience assessment tool, the applicability of BRIC to measure suburb-level resilience using aggregated meshblock level data could present significant challenges, as data that represent at this geographic level are predominately collected through the New Zealand census. As such, census questions dictate what data are collected at this level. Third, and more importantly, the applicability of BRIC's indicators within the New Zealand context needs to be examined. For indicators that are not applicable, as noted in Table 5, there is a need for replacement indicators and indicator variables that reflect the realities of New Zealand's governance structures, social and community norms and institutions, as well as other physical infrastructure and environmental factors.

The findings of this report are similar to those reported in a study by Singh-Peterson et al. (2014), in which they attempted to apply BRIC for the Sunshine Coast in Australia. Not only did they find difficulties in the selection of variables, but study participants (e.g., emergency practitioners) who provided input in the BRIC translation critiqued the applicability of the indicators used in the assessment tool. Although the study used an earlier version of BRIC, which was criticised for not including any environmental indicators and considering the links between environmental factors with that of economic resilience, the authors of the study questioned the applicability of BRIC indicators in assessing localised conditions. They also argued that the indicators of this top-down assessment tool are too homogenous to reflect the diversity of resilience levels across different areas within the region.

7.2 Moving forward: Opportunities in assessing community disaster resilience

Although the availability of data in New Zealand and the applicability of BRIC indicators make for an imprudent direct translation of BRIC indicators from the U.S. to New Zealand, the underlying theoretical framework – that is, the disaster resilience of place model (DROP) – provides a sound empirical basis for developing New Zealand-specific indicators. The various dimensions of resilience of the DROP model have been empirically shown to support the efficacies of preparedness, response, and recovery activities. A way forward is to incorporate indicators and indicator variables from BRIC with those available in New Zealand. Additional indicators and indicator variables that could potentially be used to assess New Zealand's resilience are listed in Table 6.

Table 6. *Potential resilience indicators and indicator variables for use to assess resilience in New Zealand*

Indicator	Variable	Basis for variable inclusion	Potential source of data
Social resilience			
Health – long term conditions	% population without long term health conditions	Canterbury Earthquake Recovery Authority, 2014	Ministry of Health
Health – health behaviours	% population not engaged in risky health behaviours	Canterbury Earthquake Recovery Authority, 2014	Ministry of Health
Health – health service utilisation	% population accessed health services in the last 12 months	Canterbury Earthquake Recovery Authority, 2014	Ministry of Health
Health – general health	% population with positive general health and well-being	Canterbury Earthquake Recovery Authority, 2014	Ministry of Health
Health and social service– workforce	# employed in health and social assistance sector	(Norris et al., 2008)	Statistics New Zealand
Community resilience			
Place attachment - perception	% of people perceived sense of community	McIvor & Paton, 2007; Paton, Mcclure, & Buergelt, 2006; Paton, 2013	NZ Quality of Life Survey 2016 (Colmar Brunton, 2016)
	% of people perceived cultural richness and diverse arts scene	Canterbury Earthquake Recovery Authority, 2014	NZ Quality of Life Survey 2016 (Colmar Brunton, 2016)
Social capital - networks	Types of social network (Bonding, Bridging, Linking)	Aldrich, 2012	NZ Quality of Life Survey 2016 (Colmar Brunton, 2016)
	Followers & engagement on CDEM group Facebook page	Paton & Irons, 2016	CDEM (e.g., WREMO)
Social capital - trust	% of people trusting others	Paton & Johnston, 2006	NZ Quality of Life Survey 2016
Critical Awareness of Disasters	# activities ('likes' and comments) on WREMO Facebook page	Paton, Burgelt, & McClure, 2006; Douglas Paton & Irons, 2016	CDEM (e.g., WREMO)
Social Capital - Collective Action	# community response planning held	Aldrich, 2011	CDEM (e.g., WREMO)
	Community Response Plan completion	Miles & Chang, 2011	CDEM (e.g., WREMO)
	# community events held	Onyx & Bullen, 2000; Tatsuki & Hayashi, 2001	
	# neighbour days held		CDEM or city council
Self-efficacy	# of water tanks sold	Paton, Mamula-Seadon, & Selway, 2013	CDEM (e.g., WREMO)
	# of grab-n-go kits sold		CDEM (e.g., WREMO)
Economic resilience			
Single parent families	Proportion of single parent families	Sherrieb, Norris, & Galea, 2010	Statistics New Zealand
Dependence of government benefits	% population not dependent on government benefits	Norris et al., 2008	Statistics New Zealand
Income equality	Ratio of the household income at the 80th percentile to the household income at the 20th percentile	Sherrieb, Norris, & Galea, 2010	Statistics New Zealand
Economic vitality – construction	Value of residential and commercial building consents approved 2004-2014	Canterbury Earthquake Recovery Authority, 2014	Statistics New Zealand
Economic vitality – retail trade	Electronic card transaction	Allan, 2013	Statistics New Zealand
Economic vitality – general	Mean sales volume of business	Burton, 2014	Statistics New Zealand
Disaster aid experience	% population claimed insurance for natural disasters	Paton & Johnston, 2006	Insurance Council of New Zealand

Institutional resilience			
School readiness	% of schools 'proactively' engaged in emergency planning (1) in curriculum development and implementation (2) drills (3) training of staff	Shaw, Kobayashi, & Kobayashi, 2004	CDEM (e.g., WREMO)
Social services agencies readiness	% of social services agencies engaged in emergency planning	Moore et al., 2004	CDEM (e.g., WREMO)
Housing/infrastructural resilience			
Sturdier non-residential building types	% of 'sound' commercial buildings	Alexander, 2012	RiskScape
Environmental resilience			
Natural buffers	% of parks and green space	Brody, Blessing, Sebastian, & Bedient, 2014	City councils

In developing New Zealand-specific resilience indicators, the author of the report recommends taking a number of issues into consideration.

- The need to benchmark both structural and cognitive dimensions of resilience

As argued by Kwok and his colleagues (Kwok et al., 2016), resilience is comprised of both structural (i.e., discrete features and characteristics) and cognitive (i.e., attitudes, beliefs, values, perceptions) characteristics. Because existing resilience evaluation tools, such as BRIC, either measure the structural or cognitive characteristics of resilience (Kwok et al., 2016), an assessment gap is to identify key indicators that reflect both the structural and cognitive resilience dimensions. Based on the different perspectives of stakeholder groups in New Zealand and the U.S., Kwok, Paton et al. (2018)have proposed a list of social and other community resilience themes (Table 6) that can form the foundation for prioritising resilience measures and variables that reflect the needs of communities.

Table 7. *Community resilience measurement themes*

Category	**Themes - community resilience**
Individual/ psychological	Individual responsibility
	Psychological well-being
	Self-efficacy
Socio-cultural	Awareness of hazard risks
	Awareness of vulnerabilities of people and structures
	Collective efficacy
	Community participation
	Culture values and practices
	Education and training
	Information and communication
	Learning from past hazard events (locally or elsewhere)
	Place attachment
	Diversity of skills
	Social networks
	Social responsibility
	Stability of population
	Understanding of potential hazard impacts and consequences
Economic	Economic resilience of individuals and communities

Infrastructural/ built	Community space and amenities
	Structural integrity of buildings and infrastructure (e.g., roads) and lifelines
Institutional/ governance	Civic infrastructure
	Experiences and effectiveness in collective action
	Unifying leadership
	Inclusiveness
	Trust
	Community planning

Note. From "A Bottom-up Approach to Developing a Neighbourhood-Based Resilience Measurement Framework", by A.H. Kwok, D. Paton, J. Becker, E.E.H. Doyle, and D. Johnston, 2018.

- Geographic scale of assessment influences the selection of indicators

Since disaster resilience is a multi-dimensional and multi-scalar concept, the selection of resilience indicators and indicator variables needs to consider their influences and limitations on assessing macro, meso, and micro levels of resilience. For instance, macro and meso indicators may not reflect micro dynamics and conditions, and micro indicators may not be scalable and allow for understanding of meso and macro trends. As expressed by Singh-Peterson et al. (2014), the variability of localised resilience conditions and dynamics is difficult to be captured by generalised indicators, and they called for a participatory approach to the development of indicators that reflect local priorities and needs. These critiques are also echoed in studies by Kwok and his colleagues (Kwok, Becker, et al., 2018; Kwok, Paton, et al., 2018) on understanding the perspectives of disaster resilience of stakeholders in Wellington region's suburbs. Their studies (Kwok, Becker, et al., 2018; Kwok, Paton, et al., 2018) found differences in how the concept of resilience and barriers to resilience are framed between different communities. Furthermore, the interaction of contextual influences across macro, meso, and micro levels contributes to varying perceptions of resilience in areas within the same geographic region. Regional and city resilience policies, for instance, might affect different communities in different ways (Kwok, Becker, et al., 2018). Applying the same resilience indicators for different communities might unintentionally result in either overestimating or underestimating levels of resilience. To minimise any biases that these indicators have, the resulting measurements of community resilience, locally-relevant indicators might need to be developed by soliciting local knowledge for different geographic areas so that the diversity of resilience influences and factors can be captured (Kwok et al., 2016; Kwok, Paton, et al., 2018; Singh-Peterson et al., 2014).

- The need to acknowledge the interaction among different levels of resilience, vulnerability, and hazard risks

As noted by Cutter et al. (2010), the BRIC assessment tool was neither developed to capture natural hazards that might affect a particular place nor intended to assess vulnerabilities. Opportunities abound in analysing the interaction across hazard risks, vulnerability levels, potential impacts and consequences, and resilience capacities. Khazai et al.(2015), for instance, developed a number of complementary measurement tools in identifying areas of vulnerabilities and capacities and measuring resilience progress. A move towards integrating these datasets and investigating the interactions between various variables and characteristics provides opportunities for further research, especially in risk modelling (Horspool, Crowley, & Kwok, 2016; The Global Facility of Disaster Risk and Recovery, 2016)

In New Zealand, progress towards integrating natural hazard risk modelling and social vulnerability is beginning to take shape through RiskScape, a risk modelling software developed jointly by GNS Science and NIWA (Kwok, 2016a). The inclusion of social vulnerability and resilience capacity indicators into RiskScape is an area ripe for research opportunities with real-world application for emergency management and city planners, policymakers, and local stakeholders as they seek to understand areas of vulnerabilities and capacities within the context of natural hazard risks and potential consequences. Therefore, future research is needed in examining the interactions across risks factors, hazard consequences, vulnerabilities, and resilience capacities.

- Inclusion of stakeholders' perspectives in the identification of resilience indicators

Finally, the identification of potential resilience indicators and indicator variables should consider and incorporate the perspectives of a cross section of stakeholders, including those who are tasked with developing disaster risk reduction (DRR) policies and programmes. Furthermore, the perspectives of stakeholders (e.g., community stakeholders) who might be impacted by those policies and programmes need to be included as well, as they will be impacted most by the DRR interventions and hazard consequences. The inclusion of stakeholders across functions and scales promotes their buy-in and engagement in the process and ensures DRR interventions are sustained (Committee on Increasing National Resilience to Hazards and Disasters & Committee on Science Engineering and Public Policy, 2012; Horney, Spurlock, Grabich, & Berke, 2016; Von Schirnding, 2002). In developing a resilience assessment tool that is relevant to decision-makers and is reflective to the needs and priorities of communities, a list of criteria for indicator selection is presented in Table 7.

Table 8. *Selection criteria of indicators for assessing community conditions*

• Be relevant both to individual citizens and to local government • Reflect local circumstances • Be based on information that can be readily collected • Show trends over a reasonable period of time • Be meaningful both in their own right and in conjunction with other indicators • Be clear and easy to understand, in order to educate and inform • Provoke change (for example in policies, services or lifestyles) • Lead to the setting of targets or thresholds

Note. From "Health in sustainable development planning: The role of indicators", by Y. Von Schirnding, 2002, p. 50.

8.0 Conclusion

This report illustrates how a direct translation of resilience indictors and indicator variables from a U.S.-based assessment tool poses both challenges and opportunities as New Zealand pursues the development of resilience indicators. To develop resilience indicators that are applicable for the New Zealand context, it is important for researchers and practitioners to consider the different resilience perspectives, evaluation approaches, and how factors at different geographic scales interact to influence community resilience, all of which have bearings on the types of indicators and indicator variables to use. Although it is essential to use existing datasets that are available in New Zealand, it is also important to determine additional types of data that are needed to capture the holistic and complex nature of resilience. As seen in past disasters in New Zealand, emergent vulnerabilities and data gaps have highlighted the need for new ways of data collection and assessment of resilience of people and groups (Canterbury Earthquake Recovery Authority, 2014). Resulting resilience measurement tools such as the CERA Wellbeing Survey, for instance, exemplify the need for collaboration among different stakeholders in the development of a tool that provides valuable information for decision-making in areas of infrastructure, health and psycho-social services, economy, the environment, and other community dimensions (Morgan et al., 2015). Hence, the development of resilience indicators for New Zealand needs to answer questions that include *resilience of whom?, resilience of what?, what is the intended purpose of resilience measurements, and how will the results of the resilience assessments be used?*

9.0 Acknowledgements

Financial support for this project was provided by Massey University's College of Humanities and Social Sciences and GNS Science, project #470SIH20-00, New Zealand.

Appendix 7 Low risk notification: Workshop

MASSEY UNIVERSITY
ALBANY

7 September 2015

Alan Kwok
[redacted]

Dear Alan

Re: Defining community social resilience and social resilience measurements

Thank you for your Low Risk Notification which was received on 2 September 2015.

Your project has been recorded on the Low Risk Database which is reported in the Annual Report of the Massey University Human Ethics Committees.

You are reminded that staff researchers and supervisors are fully responsible for ensuring that the information in the low risk notification has met the requirements and guidelines for submission of a low risk notification.

The low risk notification for this project is valid for a maximum of three years.

Please notify me if situations subsequently occur which cause you to reconsider your initial ethical analysis that it is safe to proceed without approval by one of the University's Human Ethics Committees.

Please note that travel undertaken by students must be approved by the supervisor and the relevant Pro Vice-Chancellor and be in accordance with the Policy and Procedures for Course-Related Student Travel Overseas. In addition, the supervisor must advise the University's Insurance Officer.

A reminder to include the following statement on all public documents:

> *"This project has been evaluated by peer review and judged to be low risk. Consequently, it has not been reviewed by one of the University's Human Ethics Committees. The researcher(s) named above are responsible for the ethical conduct of this research.*
>
> *If you have any concerns about the conduct of this research that you wish to raise with someone other than the researcher(s), please contact Dr Brian Finch, Director (Research Ethics), telephone 06 356 9099, extn 86015, e-mail humanethics@massey.ac.nz".*

Please note that if a sponsoring organisation, funding authority or a journal in which you wish to publish requires evidence of committee approval (with an approval number), you will have to provide a full application to one of the University's Human Ethics Committees. You should also note that such an approval can only be provided prior to the commencement of the research.

Yours sincerely

BT Finch.

Brian T Finch (Dr)
Chair, Human Ethics Chairs' Committee and
Director (Research Ethics)

cc Professor David Johnston and Dr Emma Hudson-Doyle
School of Psychology-Joint Centre of Disaster Research
Palmerston North

Professor James Liu
Head of School of Psychology
Palmerston North

Appendix 8 Low risk notification: Focus groups

Date: 01 February 2016

Dear Alan Kwok

Re: Ethics Notification - **4000015451 - Focus Group Discussions on Social Resilience of Communities to Disasters**

Thank you for your notification which you have assessed as Low Risk.

Your project has been recorded in our system which is reported in the Annual Report of the Massey University Human Ethics Committee.

The low risk notification for this project is valid for a maximum of three years.

If situations subsequently occur which cause you to reconsider your ethical analysis, please contact a Research Ethics Administrator.

Please note that travel undertaken by students must be approved by the supervisor and the relevant Pro Vice-Chancellor and be in accordance with the Policy and Procedures for Course-Related Student Travel Overseas. In addition, the supervisor must advise the University's Insurance Officer.

A reminder to include the following statement on all public documents:
"This project has been evaluated by peer review and judged to be low risk. Consequently, it has not been reviewed by one of the University's Human Ethics Committees. The researcher(s) named in this document are responsible for the ethical conduct of this research.

If you have any concerns about the conduct of this research that you want to raise with someone other than the researcher(s), please contact Dr Brian Finch, Director - Ethics, telephone 06 3569099 ext 86015, email humanethics@massey.ac.nz. "

Please note, if a sponsoring organisation, funding authority or a journal in which you wish to publish requires evidence of committee approval (with an approval number), you will have to complete the application form again, answering "yes" to the publication question to provide more information for one of the University's Human Ethics Committees. You should also note that such an approval can only be provided prior to the commencement of the research.

Yours sincerely

Dr Brian Finch
Chair, Human Ethics Chairs' Committee and Director (Research Ethics)

Research Ethics Office, Research and Enterprise
Massey University, Private Bag 11 222, Palmerston North, 4442, New Zealand **T** 06 951 6841; 06 95106840
E humanethics@massey.ac.nz; animalethics@massey.ac.nz; gtc@massey.ac.nz

Appendix 9 Information sheet: Workshop

MASSEY UNIVERSITY
TE KUNENGA KI PŪREHUROA
UNIVERSITY OF NEW ZEALAND

Workshop discussions on social resilience of communities

INFORMATION SHEET

Introduction

A workshop is being held to study social resilience of communities to disasters. This workshop is being conducted as part of Alan Kwok's PhD research project. The purpose of the research is to:

- Explore how social resilience is viewed from the perspectives of researchers, disaster management professionals, policy makers, and private sector and community stakeholders;
- Understand how these perspectives have been put into practice;
- Determine how social resilience has been evaluated and measured by different groups, organisations and agencies.

The findings from the study will be used to develop a framework for social resilience that seeks to capture the following elements:

- Social resilience dimensions and indicators
- A guide to possible measurements

This workshop is part of a larger research programme to build safer communities by enhancing existing understanding of how communities can increase their social resilience before a disaster, as well as incorporating the research findings into community capacity-building programmes and evaluation tools.

To carry out this research, this workshop is being facilitated to examine the different perspectives of social resilience and how these perspectives have been put into practice. The focus is on community-level social characteristics, conditions, and processes. This research is interested in the experiences of the general public, community groups, and those working in research, government and private organisations.

Funding for this project has been provided by Massey University's College of Humanities and Social Sciences and GNS Science.

Participant Recruitment and Involvement

The workshop will be held on 15 October 2015 from 2:00-4:30pm at the Wellington Region Emergency Office at 2 Turnbull St., Thorndon, Wellington. A general invite has been sent out for people to volunteer to attend this workshop. This workshop will accommodate up to 25 people and will take approximately two and a half (2.5) hours. Light refreshments will be provided during the workshop.

Participants must be 18 years of age or over. Participants will not be identified as individuals in the research findings - discussions in the workshop will be reported anonymously and results generalised.

Project Procedures

Group discussions will be undertaken in person, and before discussions start, all participants will be informed again about the research, and about their rights as participants. Participants will be asked to sign a consent form if they have not already done so.

Discussions will be taped and transcribed only with all participants' consent. If requested, individuals will be sent the group transcripts to check and confirm the accuracy of the transcripts. Themes will be extracted from the transcriptions and only general findings will be reported. Consent sheets and pre-interview information will be stored separate from group transcriptions to ensure participants' anonymity. Project results will be made available to participants in a variety of formats.

All data will be collected, used and stored in compliance with the Massey University Code of Ethical Conduct.

Participant's Rights

You are under no obligation to accept this invitation. If you decide to participate, you have the right to:

- decline to answer any particular question;
- withdraw from the study at any time before the results are sent for publication;
- ask any questions about the study at any time during participation;
- provide information on the understanding that your name will not be used unless you give permission to the researcher;
- ask for the audio recording to be turned off at any time during the group discussion;
- be given access to a summary of the project findings when it is concluded.

Project Contacts

For further information about the project, please contact:

Alan Kwok, Massey University – Joint Centre for Disaster Research, P.O. Box 756, Wellington
Ph: [redacted], a.h.kwok@massey.ac.nz

Project Evaluation

This project has been evaluated by peer review and judged to be low risk. Consequently, it has not been reviewed by one of the University's Human Ethics Committees. The researcher named above is responsible for the ethical conduct of this research.

Joint Centre for Disaster Research, School of Psychology, Massey University
P.O. Box 756, Wellington 6140, New Zealand

Appendix 10 Participant consent form: Workshop

Workshop Discussions on Social Resilience of Communities

PARTICIPANT CONSENT FORM

I have read the Information Sheet and have had the details of the study explained to me. My questions have been answered to my satisfaction, and I understand that I may ask further questions at any time.

I understand that the workshop will involve group exercises and a group discussion.

I agree to the workshop sound recorded.

I agree to the workshop being video recorded.

I agree to participate in this study under the conditions set out in the Information Sheet.

Signature: ..... **Date:** .....

Full Name - printed .....

Appendix 11 Structured workshop agenda

Workshop Discussions on Social Resilience

15 October 2015

2:00-4:30pm, WREMO

AGENDA

Objectives:

- To explore how social resilience is viewed from the perspectives of researchers, disaster management professionals, policy makers, and private sector and community stakeholders.
- To understand how these perspectives have been put into practice
- To determine how social resilience has been evaluated and measured by different groups, organisations and agencies.

Time	Agenda Item
2:00pm – 2:05pm	Welcome
2:05pm – 2:10pm	Overview of workshop objectives
2:10pm – 2:25pm	Introduction – Setting the stage
2:25pm – 3:05pm	What is social resilience?
3:05pm – 3:20pm	Tea break
3:20pm – 4:00 pm	Temporal dimensions of social resilience
4:00pm – 4:20pm	How policies and programmes are evaluated
4:20pm – 4:30pm	Closing

Appendix 12 Facilitation outline for focus groups

Focus Groups on Social Resilience of Communities

Run sheet

Time (mins)	Activity	Speaking points/Question(s) to ask
0:00 – 2:00	Welcome and introduction / housekeeping	In case of emergency… Introduce focus group facilitator (name, occupation, Wellington/SF background)
2:00 – 8:00	Consent	• Discuss tape recorders. • Discuss how information will be used/confidentiality. • Collect consent forms
8:00-12:00	Welcome	Welcome participants – introduce each other • *What is your (first) name?* • *Do you live or work here?* • *What is your favourite place to go in (neighbourhood name)?*
12:00-20:00	Purpose of research Focus group procedures and guidelines	Describe purpose: Script: *The purpose of tonight's focus group is to understand your thoughts and opinions about the resilience of (name of suburb/ neighbourhood).* *You will be asked a series of questions.* Discuss ground rules: **see below**
20:00-70:00	Focus group discussions	**See below**
70:00-75:00	Closing & thank you	• Provide contact information with questions • Reiterate how the data will be used • Request contact information if participants want to know about the results of the research • Give out thank you gift cards • Have participants sign acknowledge of gift cards form.

Ground rules

Script:

- ***WE WANT YOU TO DO THE TALKING.*** *We would like everyone to participate. I may call on you if I haven't heard from you in a while.*
- ***THERE ARE NO RIGHT OR WRONG ANSWERS*** *Every person's experiences and opinions are important. Speak up whether you agree or disagree. We want to hear a wide range of opinions.*
- ***WHAT IS SAID IN THIS ROOM STAYS HERE*** *We want folks to feel comfortable sharing when sensitive issues come up.*
- ***WE WILL BE TAPE RECORDING THE GROUP*** *We want to capture everything you have to say. We don't identify anyone by name in our report. You will remain anonymous.*

Focus group questions

<table>
<tr><td><u>Setting the stage</u>
The first set of questions asks about the general strengths and character of participants' community.</td><td rowspan="2">Initial Questions</td><td>1. How would you describe (name of suburb/neighbourhood)? (Write down responses)
o Why do you think that?
o What contributes to your response(s)? (e.g., resources, relationships, etc.)
o What do you like about living in (name of suburb/neighbourhood)?
o How would you describe the character or values of (name of suburb/ neighbourhood)?</td></tr>
<tr><td><u>Discuss community resilience – warm up</u>
Script: This workshop is to get your views on community resilience.</td><td>2. When you hear the phrase 'community resilience,' what do you think of? (Write down responses)
o Why do you think that?</td></tr>
<tr><td><u>Community resilience within the context of disasters</u>
Script: Let's look at community resilience to disasters. When I say disasters, I mean disasters caused by mother nature - like earthquakes, tsunamis, climate and weather-related events.</td><td colspan="2">3. When I say 'community resilience to disasters,' what does it mean to you?
o Is there anything you want to add to your previous response?
o How is your response different than that from the previous question?

Summarise what participants have said about community resilience.

If necessary, present a definition of community resilience (abridged from Paton's and WREMO's definitions) to transition to the next section:

Community resilience is the capability to draw upon the resources and competencies to anticipate, cope with, adapt to, bounce back rapidly and learn from the challenges and changes encountered before, during and after disaster</td></tr>
<tr><td><u>Core questions – general resilience</u></td><td colspan="2">4. What does (name of suburb/neighbourhood) need in order to anticipate, cope with, and overcome the challenges and changes of a disaster, such as an earthquake?</td></tr>
</table>

Delve into participant's responses by asking: • Where do your views come from? • Why do you think [attributes] would be useful/effective? (e.g. skills, processes) • Do you think your community has these [attributes] • How these [attributes] been developed in your community?	○ What <u>skills, abilities and knowledge</u> do you think (name of suburb/neighbourhood) would need? ○ What <u>community resources</u> - physical assets or goods and services - are vital to help (name of suburb/neighbourhood) overcome a disaster? ○ What kind of community <u>values and beliefs</u> do you think (name of suburb/neighbourhood) would need to have to help it overcome a disaster?
Closing questions	5. What is one thing that (names of suburb/neighbourhood) needs the most to improve its resilience to disasters? ○ Tell me why you selected it. 6. Is there anything else you would like to discuss or add?

Appendix 13 Information sheet: Focus groups

MASSEY UNIVERSITY
TE KUNENGA KI PŪREHUROA
UNIVERSITY OF NEW ZEALAND

Focus Group on Social Resilience of Communities to Disasters

INFORMATION SHEET

Introduction

This focus group is being held to study social resilience of communities to disasters. This focus group is being conducted as part of a PhD research project by Alan Kwok, a PhD student at the Joint Centre for Disaster Research at Massey University, New Zealand. The purpose of the research is to explore the perspectives of residents and community stakeholders on their community resilience to potential disasters.

The findings from the study will be used to develop a measurement tool to assess social resilience of local communities.

This focus group is part of a larger research programme to build safer communities by enhancing existing understanding of how communities can increase their social resilience before a disaster, as well as incorporating the research findings into community capacity-building programmes and evaluation tools.

To carry out this research, this focus group is open to people living or working in selected suburbs/neighbourhoods.

Funding for this project has been provided by Massey University's College of Humanities and Social Sciences and GNS Science.

Participant Recruitment and Involvement

A number of focus groups will be held in Cannons Creek, Porirua. Each focus group comprise of 6-7 participants. Each focus group will last for 1 hour and 30 minutes.

Light refreshments will be provided during the workshop.

Participants must be 18 years of age or over. Participants will not be identified as individuals in the research findings - discussions in the workshop will be reported anonymously and results generalised.

Project Procedures

Focus groups will be undertaken in person, and before discussions start, all focus group participants will be informed again about the research, and about their rights as participants. Participants will be asked to sign a consent form if they have not already done so.

Discussions will be taped and transcribed only with all participants' consent. If requested, participants will be sent the group transcripts to check and confirm the accuracy of the

transcripts. Themes will be extracted from the transcriptions and only general findings will be reported. Consent sheets and pre-interview information will be stored separate from group transcriptions to ensure participants' anonymity. Project results will be made available to participants in a variety of formats.

All data will be collected, used and stored in compliance with the Massey University Code of Ethical Conduct.

Participant's Rights

You are under no obligation to accept this invitation. If you decide to participate, you have the right to:

- decline to answer any particular question;
- withdraw from the study at any time before the results are sent for publication;
- ask any questions about the study at any time during participation;
- provide information on the understanding that your name will not be used unless you give permission to the researcher;
- ask for the audio recording to be turned off at any time during the group discussion;
- be given access to a summary of the project findings when it is concluded.

Project Contacts

For further information about the project, please contact:

Alan Kwok, Massey University – Joint Centre for Disaster Research, P.O. Box 756, Wellington
a.h.kwok@massey.ac.nz

Phone (New Zealand): [redacted]

Project Evaluation

This project has been evaluated by peer review and judged to be low risk. Consequently, it has not been reviewed by one of the University's Human Ethics Committees. The researcher named above is responsible for the ethical conduct of this research.

Joint Centre for Disaster Research, School of Psychology, Massey University
P.O. Box 756, Wellington 6140, New Zealand

Appendix 14 Consent form: Focus groups

Massey University
Joint Centre for Disaster Research, School of Psychology, Massey University
P.O. Box 756, Wellington 6140, New Zealand

Workshop Discussions on Social Resilience of Communities

PARTICIPANT CONSENT FORM

I have read the Information Sheet and have had the details of the study explained to me. My questions have been answered to my satisfaction, and I understand that I may ask further questions at any time.

I understand that the focus group will involve group discussions.

I agree to the focus group being sound recorded.

I agree to participate in this study under the conditions set out in the Information Sheet.

Signature: ..... **Date:** .....

Full Name - printed .....

Appendix 15 Consolidated themes, sub-themes, and codes from focus group transcripts

THEME	SUB-THEME/CODE	SUB-THEME/CODE	CODE
Awareness of hazard risks	Geological features - pose as risks or mitigate impacts		
	Perceptions of likelihood, frequency, and magnitude		
Awareness of vulnerabilities of people and infrastructure	Aware of limitation of Civil Defence in DRR response		
	Infrastructural issues	Buildings not up to code	
		Density of buildings creates hazard risks	
	Needs of vulnerable populations	Access to information from Civil Defence	
		Require welfare support	
	Vulnerable populations to be affected	Low-income (potentially more resilient)	
		Non-English speakers	
		People who are illiterate	
		Seniors	
		Working parents	
Civic infrastructure	Foundation for building resiliency		
	Functions of civic infrastructure	Advocate for residents	
		Building skills and knowledge	Educating the community, esp. vulnerable populations
			Facilitate leadership building
			Source of information
		Create a sense of safety	

		Create opportunities for development of social networks
		Provide gathering places for residents
		Positive community-building
		Provide capacity building for other CBOs
		Provide coordination and partnerships between CBOs
		Provide social support
		Provide shelter
		Provide recreation opportunities
		Resolve community conflicts
		Support youth development
	Need for a CBO dedicated to disaster preparedness	
	Types of civic infrastructure	Schools and churches
		Centre for seniors
		Community-based organisations (CBOs)
Collective efficacy and actions	Collectively organised	
	Empowerment through coming together	
	Need for organisation and coordination of residents	
	Outcomes of collective efficacy and actions	Optimism
		People able to move forward/perseverance
Community participation	Need mechanisms to have people come together	Block party
		Community events
		Community gardens
		Community-based issues to rally community participation

Community planning	Challenges in planning	Not planning enough	
		Planning for uncertainty	
	Community plan has different components	Community disaster simulations	
		Community register - skills and supplies	
		Consideration of vulnerable population	
		Emergency plans for CBOs	Need for accountability of updating plans
		Gathering point(s)	
		Need for community evacuation plan	
		Plan for temporary housing and shelters	
		Tie in with community events	
	Planning has benefits to disaster response		
	Public-private partnerships in planning		
Community space and amenities	Community amenities	Civil Defence centre	
		Food sources	
		Retail	
		Storage facilities	
	Community place	Centralized location	
		Functions of a community space	A place for dialogue, debate, and planning
			Community events
			Connect to external resources
			Facilitate organisation of people/resources
			Facilitate social connections
			Serve as a family reunification/check point
			Source of information
	Need for neutral spaces		

	Need for positive community spaces for residents	
	Support development of sense of community	
Cultural values and practices	Acceptance of cultural diversity	
	Cultural influences on family structures	Grandparents essential
		Importance of 'extended family' members
	Diversity of languages as assets and challenges	
	Historical legacies shaping today's resilience	Shaping community and business climate
		Shaping the present's resilience
	Importance of place/culture to populations	
	Intergenerational differences on cultural beliefs	
	Need for culturally appropriate services	
	Need for preserving community culture/identity	
Diversity of skills	Ability to obtain resources	
	Adaptiveness and flexibility	
	Different skills needed	
	People as assets	
Economic resilience of individuals and communities	Importance of community-based economy pre and post disasters	
	External economic and financial pressures on mobility of residents and businesses	
	Need financial investments in community	
	Need to be financially educated	
	Need for transfer of homeownership within family vs than outsiders	
	Job security after disaster	
	Need for homeowner’s insurance	
	Job subsidies provided by govt after disaster	

	Shared economy through social media		
Education and training	Need for community-based preparedness education	Community meetings and events on emergency preparedness	
		Education targeting seniors and youth	
		Education to be presented in culturally competent ways	
		Know Civil Defence point	
		Need to be on-going and visible	
	Community drills		
	Need for community outreach and engagement		
	Outcomes - education and training	Increased awareness for long-term recovery	
		Trained residents on preparedness and response	
Governance – Unifying leadership and inclusiveness	Community governance processes	Need for fairness	
		Need for accountability	
		Need for transparency	
		Ease of engagement and support	
		Communication and mediation	
		Recognition that government not know all the needs of communities	
	Functions of community governance	Advocacy for community in policy making	Community preservation
			Policies and programmes that protect residents
	Need for community organizing		
	Take advantage of local policies to work for community		
	Need for community-based leadership		
Individual responsibility	Need for individual preparedness	Align with everyday planning and actions	
		Have a plan	

		Have supplies
		Know when, where, and who to request community resources
	Help prepare vulnerable residents	
	Help prepare family and neighbours	
	Motivating DRR actions	Examples of past community initiatives
		Individual incentives to get people involved
		Instil willingness to be resilience
	Outcomes from people taking individual responsibilities	Individual sufficiency
		Safety of families
		Support sufficiency of community
Information and communication	Awareness of existing warning systems and emergency resources	
	Communication infrastructure	Radio
		Social media and apps
	Need for dissemination of disaster messages to community	
	Need for information sharing	
	Need for mapping of essential physical resources	
	Young people as assets in DRR education and information dissemination	
Learning from past hazard events	Past disaster experiences build community resilience	
	Relate to understanding of potential hazard consequences	
	Recovery as a long process - temporal scale	
Place attachment	Familiarity and friendliness of people	
	Importance of place to people	
	Ownership in improving community	

Psychological well-being	Cultural relevancy of services	
	Progress through time	
	Psychological and emotional support	
	Underlying well-being issues	
Social networks	Need opportunities for connecting with neighbours	
	Importance of social networks on disaster preparedness	
	Outcomes of social networks	Ease of acting collectively
		Extending services and goods to others
		Reduction in time to act
		Support from neighbours and community-based resources
	Source of social networks	
	Types of social capital	Based on shared interests and experiences
		Families and friends
		Know people outside of neighbourhood
		Transition from geographic-based to interests-based
	Underlying connections already have structures	
	Uneven connectedness among residents	
Social responsibility	Ability to help other communities	
	Functions of social responsibility	Emergency response
		Ensure safety and well-being of neighbours
		Facilitate communication
		Help maintain family structures
		Preparing for others

		Provide social support	
	Need proactive neighbours who want to know each other		
	Need trust	Need accountability	
		Trust between neighbours	
	Outcomes of social responsibility	People don't turn against each other	
		Community coming together	
Stability of population	Demographic changes - inclusion and acceptance	Acceptance of newcomers	
		Adapting to changing demographics	
		Challenges in demographic changes	Changing cultural fabric of the community
			Low income and minorities moving out
			Newcomers want low income and minority residents out
	Stability of residents	Families with children	
		High homeownership	
		Long tenure of residents and workers	
Structural integrity of buildings, infrastructure and lifelines	Accessibility in and out of community		
	Need for stronger building regulations		
	Outcome: Maintaining functionality of community assets - services and infrastructure		
	Structural integrity of buildings		
Understanding of potential hazard impacts and consequences	Drawing on past disaster experiences and examples		
	Negative impacts	BBB community will exclude people at certain socioeconomic level	
		Change in physical size of community	
		Change in residents and culture and community character	

		Conflicts between neighbours	
		Corporations overtaking community redevelopment	
		External support dependence on individual preparedness	
		Lack of essential services and supplies	Lack of basic supplies (e.g. food, shelter, medical, power, gas)
			Lack of road access
			Loss of community amenities
			Loss of critical infrastructure and city services
		Looting and thefts	
		Shifting of services outside of region	
		Uneven impacts within neighbourhood	
		Vulnerable populations affected most	
	Need consideration of animals		
	Need communication from service providers		
	Need retention of populations		
	Positive impacts	Adverse events bring community together	Altruistic behaviours
			Shared experiences
		Opportunity to build back better (BBB)	

Appendix 16 Attributes of a resilient community – Thematically analysed responses to the statement, "A resilient community is/has…"

Theme (and number of references)
Adaptiveness (3)
Collective efficacy (2)
Communication (3)
Connected (3)
Courage (1)
Diversity - businesses and services (1)
Doers (1)
Good governance (18)
Is coordinated
Is participatory and engaged (2)
Has plans/planning (5)
Has sense of shared responsibility
Possesses leadership abilities - grassroots and governments (8)
Is stable
Identity - individual and community (2)
Infrastructure (3)
Infrastructure (2)
Gathering place (1)
Knowledge of (9)
Hazards and risks (2)
Community assets and gaps (5)
Capacities (2)
Networks (4)
Open spaces
Options
Positive outcome expectancy
Resources (6)
Self-efficacy (2)
Sense of community (2)
Shared interests
Skills and capabilities (3)
Capabilities (1)
Organizing skills (1)
Decision-making skills (1)
Supportive
Transportation options
Trust

Appendix 17 Unanalysed attributes of social resilience, by categories

Social resilience category	Social resilience attribute
Skills, abilities and knowledge	Ability to problem solve together Ability to translate risk into actionable (local) knowledge Adaptability/willingness to embrace change Counselling skills Diverse sets of skills/thinking among a group of people Empathy skills Energy and wisdom Knowledge of social/physical assets and vulnerabilities Knowledge/understanding of hazard impacts Leadership skills Mediators Perseverance Sufficient trained personnel Understanding need to prepare Ways to support households without water or electricity
Community qualities and amenities	Access to assets, tools, guides, etc. Communication channels connecting all of the community Community cohesion (e.g., cafes) Community identity (e.g., cafes) Community pride Designated area to gather Economic, natural environment, infrastructure resilience Green spaces In rural areas, need a fully functioning fire service (voluntary fire brigade) able to deal with a range of emergencies, including first aid Need economic resources to free up time to plan and act/provide support (e.g., emergency funds and insurance) Older citizens' wisdom/knowledge Robust community facilities - halls, schools, medical centres Social networks (e.g., service clubs and organised sectors) Spaces where different people/groups can connect Well-attended farmers' markets

Community values and perceptions	Compromise for the greater good Ethics Feeling of attachment to their community (people and businesses) Inclusiveness of diverse groups Perceives a positive outcome is possible - confidence in abilities Respect for others Self-reliant (no CDEM Army) Sense of belonging Sense of place and identity Sense of safety (emotional and physical) Shared community values and beliefs Trust within networks Willingness to do things for others
Community processes	A framework for coming together with purpose Clear communication channels Connectedness between groups and systems Elected representatives Formal/informal institutions to meet, discuss about disaster risk management Has a community decision-making process (+/or governance) Lively volunteer programmes Local festivals/events with community-wide participation Organised meetings of same and diverse groups Plan of action and practise responses Problem definition and representation Process to voice ideas (e.g., under-represented groups) and problem solve Processes for using individual skillsets for common good Use democratic processes without discriminating people from different parts of communities