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PREPAREDNESS OF SMALL TO MEDIUM-SIZED ENTERPRISES TO EARTHQUAKE DISASTER: NAPIER AND DUNEDIN CASE STUDIES

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ABSTRACT

Small to Medium-sized Enterprises (SMEs) are often vulnerable to the adversities caused by major earthquake events, which may include business disruption, damage to goods and property, impaired employee health and safety, financial strain and loss of revenue, or even total loss of the business. SMEs are expected to make critical decisions to prepare their businesses for an earthquake, in an attempt to ensure business continuity and the wellbeing of their employees, should a disaster occur. This study was conducted five years after the devastating Canterbury earthquakes and sought to examine the level of earthquake preparedness of SMEs by investigating the actions undertaken in two different suburban locations having differing seismicity. The extent of preparedness was assessed based on a list of twenty-one possible actions grouped into four categories being knowledge enrichment, insurance and business continuity, survival support actions, and seismic damage mitigation. The assessment involved a survey with an online questionnaire. Analysis of the collected data revealed a specific adoption pattern in the regions of study. The main preparedness action adopted by SMEs was the purchase of business insurance with the development of continuity plans. The least obtained preparedness action was related to survival support actions such as maintaining necessary emergency supplies. The overall adoption rate of the preparedness actions was less than 30%, with no significant difference between the regions studied, and close to 50% of SMEs having adopted less than five preparedness actions. This situation clearly requires urgent attention from all stakeholders involved in SMEs resilience before an earthquake disaster hits the regions.

INTRODUCTION

New Zealand regions are vulnerable to earthquake hazard, although some regions are more prone to earthquakes than are others. Historical trends and records dating from the 1840s suggest that New Zealand experiences several magnitude six earthquakes every year, one magnitude seven earthquakes every ten years, and a magnitude eight earthquake every century [1]. These earthquakes can disrupt businesses, which represent the constituents of the local, regional, and national economy. A major share (97%) of businesses in New Zealand comprised of small to medium enterprises (SMEs), with Ministry of Business [2] defining an SME as a unit which consists of between 0 to 49 full-time employees. These SMEs may include companies, partnerships, trusts, or self-employed individuals, and they employ 30% of the country's working population while producing approximately 27% of its Gross Domestic Product [3].

Recognising the earthquake threat and learning from the Canterbury earthquake events, SMEs are expected to develop their adaptive capacity to maintain their important functions and recover quickly when the disasters occur [4]. A systematic approach to deal with the disaster effects and risks can include a combination of pre-disaster measures and post-disaster actions [5-8]. This systematic approach can be further divided into four phases of mitigation, preparedness, response, and recovery [9, 10], as shown in Figure 1. The Mitigation involves the actions taken to identify and examine long-term risks to human life and their properties. These risks and the degree of their effect should be eradicated if possible, given their probability of reoccurrence. This practice involves reducing the exposure to the seismic hazard, reducing the vulnerability of people and property, judicious management of land and environment, and enhanced preparedness for adverse effects. The Preparedness includes taking the measures to develop working schemes and capabilities prior to a disaster [11]. The Response deals with protecting lives and properties by taking immediate actions before the disaster, during the disaster, or just after the disaster. The Recovery concerns with efforts and processes that will give rise to an immediate, medium and long-term redevelopment of an area, after the disaster event.

Actions undertaken at the preparedness phase can reduce the immediate risk of damage and loss during an earthquake event, and can lead to less reliance on the emergency responses, which in turn frees up resources for other tasks [7,12,13]. Therefore, the level of pre-disaster preparedness of the organisation is recognised as one of the contributing factors to post-disaster response, recuperation and continuity [14-16]. This paper investigates the preparedness level of SMEs for a potential earthquake in two regions of New Zealand with varying

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seismicity, hazard factor, earthquake probability and likely severity. The results provide key information about the number and characteristics of the preparedness measures adopted by these enterprises and could outline approaches to improve the resilience of SMEs to earthquakes, which ultimately could enhance the resilience of the New Zealand community as a whole.

Figure 1: The cycle of disaster management.

RESEARCH BACKGROUND

A plethora of research exists regarding the key elements of preparing for natural disasters with a substantial variation in the suggestions about the necessary actions to be undertaken. The suggested actions involve a combination of initiatives at the individual, community and organisational levels. Table 1 gives a summary of 49 prominent studies in this field and the number of preparedness actions that they have included. Early studies used a free response method to collect the steps individuals had taken to prepare for an earthquake [17]. These studies used open-ended questions, which requested for a long response with the main purpose of communicating ideas free from the effects of preconceptions of the researcher. Checklists were developed respectively to examine the preparedness items adopted in different contexts such as for businesses in Tierney [18], households in Lindell and Hwang [19], firms in Sadiq [13], and communities in Howe [20].

Consistent with this research stream, the disaster threat to private businesses and their preparedness have attracted significant attention over the recent decades. Business preparedness is defined as the series of actions that aim to enhance the ability of this social unit to respond to a disaster event. It may involve any initiative that has the potential to save lives, lessen property damage, and reduce the negative impacts of the disaster [65,66]. The preparedness process begins with hazard and vulnerability analyses of the units to anticipate the likely impacts and proceeds with the development of ways to address these impacts [67]. This process of disaster preparedness can increase control over the subsequent disaster response at the individual, organisational, and community levels [65].

Table 1: Possible earthquake preparation measures for SMEs.

Group 1. Knowledge Enrichment Activities		Group 2. Insurance and Business Continuity Plans		Group 3. Emergency Survival Actions		Group 4. Damage Mitigation Actions	
No	**Actions**	**No**	**Actions**	**No**	**Actions**	**No**	**Actions**
1	Received written information on earthquake preparedness	6	Purchased business contents insurance	11	Obtained a first aid kit, extra medical supplies	16	Ensured a backup of computer and electronic data
2	Discussed with employees about earthquakes	7	Purchased business interruption insurance	12	Stored water and canned food	17	An engineer conducted a seismic assessment of the building
3	Attended a first aid course	8	Purchased earthquake insurance to cover damage to the building	13	Stored extra fuel or batteries	18	Braced shelves, cabinets or objects
4	Conducted earthquake drills or exercises for the employees	9	Developed a business disaster recovery plan	14	Made an arrangement for a business relocation plan in case of an Earthquake	19	Heavy objects are stored on the floor
5	Supported earthquake preparedness or training programs for employees	10	Developed a business emergency plan for the event of an earthquake	15	Obtained an emergency generator for power failure	20	Business records and supplies are secured
						21	The building is retrofitted to a higher seismic performance

From the wide variety of possible actions indicated by studies to date, a total of twenty-one actions are recognisable as particularly applicable to SMEs. These actions relate to the specific characteristics of SMEs including their operational size, type and common ownership structure. The recognised preparedness actions can be attributed to broader categories of learning, planning, survival support and damage mitigation initiatives adhering to the suggestions of Russell [62]. The learning category indicatives assist in acquiring information about skills to respond to a disaster such as the first aid and disaster preparedness and emergency training programs. These are actions that stimulate critical awareness about the consequences of an earthquake and inspire developing specific skills [12]. The planning actions reflect cognitive preparation and resource allocation, such as the purchase of earthquake insurance. A business unit may also prepare a plan to protect itself against the financial consequences of the disaster, and keep its core parts up and running after the disaster. The survival support actions such as collecting and maintaining supplies can support the emergency management and survival

of the affected social units after the disaster [39,68]. The damage mitigation actions help to reduce damage and deaths in the case of a disaster. McClure, et al. [68] distinguished these actions into building damage and contents damage. A summary of the 21 preparedness actions and the four broader categories are provided in Table 1.

RESEARCH METHOD

The research utilised a quantitative approach as the primary data collection source. It conducted an online questionnaire prepared based on the suggestions of Dillman, et al. [69], and hosted it on Survey Monkey website. SMEs were invited to participate from two urban areas in New Zealand indicated in Figure 2. The main characteristics of the urban areas that made them suitable for this study were as follows:

Figure 2: The cities selected for the case studies.

Napier

Napier is situated in a zone of high seismic hazard with a risk factor of $Z \geq 0.3$ [70]. The seismic hazard indicates the probability that an earthquake will occur in an area, within a given timeframe, and with an intensity that exceeds a given threshold. The city accommodates 1.3% of New Zealand's population, and it is the home of around 18,360 businesses [71]. It experienced serious damages after the Hawke's Bay earthquake in 1931. This earthquake disaster was, however, the main reason that prompted the rise of a distinctive Art Deco design style in the city. The style turned into a noteworthy fascination that contributed to a financial boost to the city [72]. Nevertheless, a significant number of these historic Art Deco structures are located in the central business district (CBD) and are considered as earthquake-prone buildings (EPBs) because of their age, deteriorating construction and deficient seismic quality. Many SMEs in Napier are the majority leaseholders or owners of these EPBs due to attractive rent prices and greater accessibility to customer foot traffic [73]. The city also comprises of territories that are susceptible to damage by soil liquefaction, flooding and tsunami [74]. According to the new concept termed priority buildings, which has been introduced on the 1 July 2017, territorial authorities within the Manawatū and Rangitīkei regions have 2.5 years to identify vulnerable buildings, and property owners must strengthen or demolish these buildings within 7.5 years. For other building types, territorial authorities are expected to identify earthquake-prone buildings within five years, and owners must strengthen or demolish these properties within 15 years. It is expected to raise the awareness of businesses in this city about the vulnerability level of their operating building.

Dunedin

In order to benchmark the situation in a low seismic risk region, Dunedin was studied. The seismic risk factor of the city has been specified as $Z < 0.15$ [70]. A small number of minor earthquakes, however, have been recorded in Dunedin over the years, with the largest magnitude of 4.9 in 1974. Dunedin that was founded by European settlers in 1848, currently hosts 28,128 businesses [71]. The city accounts for one-quarter of New Zealand's total earthquake-prone building stock. An initial evaluation showed an approximate number of 750 unreinforced masonry earthquake-prone buildings, most of them set in the central business district [75]. Parts of Dunedin are also known to be susceptible to ground shaking amplification, liquefaction, and tsunami hazards [75,76]. The priority building concept of managing earthquake-prone buildings is not mandatory for locations classified as low seismic risk regions. Consequently, Dunedin City Council is given five years to identify earthquake-prone buildings, and owners of these vulnerable buildings are expected to strengthen or demolish their properties within 15 years.

The main attributes of the two cities selected for this study are outlined in Table 2.

Sampling Frame and the Response Rates

Sampling presents the process of selecting the units of observation (such as a subset of people or organisations from a population of interest) with the objective of obtaining knowledge and generalising results back to the original population [77]. The population frame of this study comprised of SMEs operating in the selected suburban areas. However, lack of access to the database consisting of the updated list of businesses and their corresponding owners inhibited the exact description of the population frame. The sampling frame of the survey was formed using data provided by the local councils. The information from the Napier City Council contained a list of approximately 167 SMEs mainly located in the earthquake-prone buildings within five kilometres in the CBD illustrated in Figure 3. Thirty-eight usable answers were received that equates to a response rate of 23%. The list from the Dunedin City Council included the information of 226 SMEs residing in earthquake-prone buildings. Thus, the response rate observed in Dunedin was 24%. These ranges are within the typical limits for a study of this nature. The selected samples are presented in Figures 3 and 4. The survey process involved an initial email invitation with the link to the online questionnaire. In case of receiving no answer from the invitees within two weeks, the survey considered a follow-up email or a phone call. The data collection proceeded within eight weeks in July and August 2015.

Table 2: Regional characteristics of the case studies conducted.

Urban areas	Seismic Risk Level	Hazard Factor	Number of active business enterprises	Population	Urban Area (km^2)	Regional Sub-national GDP
Napier	High	Z ≥ 0.3	18,360	57,240	140.28	2.8%
Dunedin	Low	Z < 0.15	28,128	127,000	255	4.3%

Figure 3: Selected samples in Napier.

SURVEY QUESTIONS DEVELOPMENT

The questions were formulated based on the operational definition of the factors in the literature and three exploratory interviews with experienced construction industry professionals. The questionnaire mainly assessed the profile of the SMEs, the number and type of preparedness actions adopted from the twenty-one measures listed in Table 1.

The Preparedness Measures Used

The extent of preparedness of the SMEs for a potential earthquake disaster was measured by counting the number of preparedness measures they had implemented, out of a possible twenty-one actions summarised in Table 1. Adhering to the suggestion by Sadiq [51], each item in the list of the preparedness measures was associated with a dummy variable. Each variable coded as 1 if it was adopted by the SME and 0 otherwise. The responses were added up to calculate the total number of preparedness actions that were adopted out of the total possible actions. This method implies that all actions are equally weighted. Despite not being free from criticism, it provides a simple and convenient way to measure the preparedness level. Accordingly, it has been the common choice of researchers in this field. Examples that have utilised a similar measurement approach include Chang and Falit-Baiamonte [78], Tierney, et al. [16], Dahlhamer and Tierney [79],Webb, et al. [80], Lindell and Prater [32], Mileti [81], Russell [62], Lindell [82], Mulilis, et al. [39], and Turner, et al. [31].

Research Ethics

This project was evaluated by peer review and judged to be low risk. Ethics approval was obtained for the project under the Massey University Low-Risk Ethics Protocols for research and evaluations involving human participants.

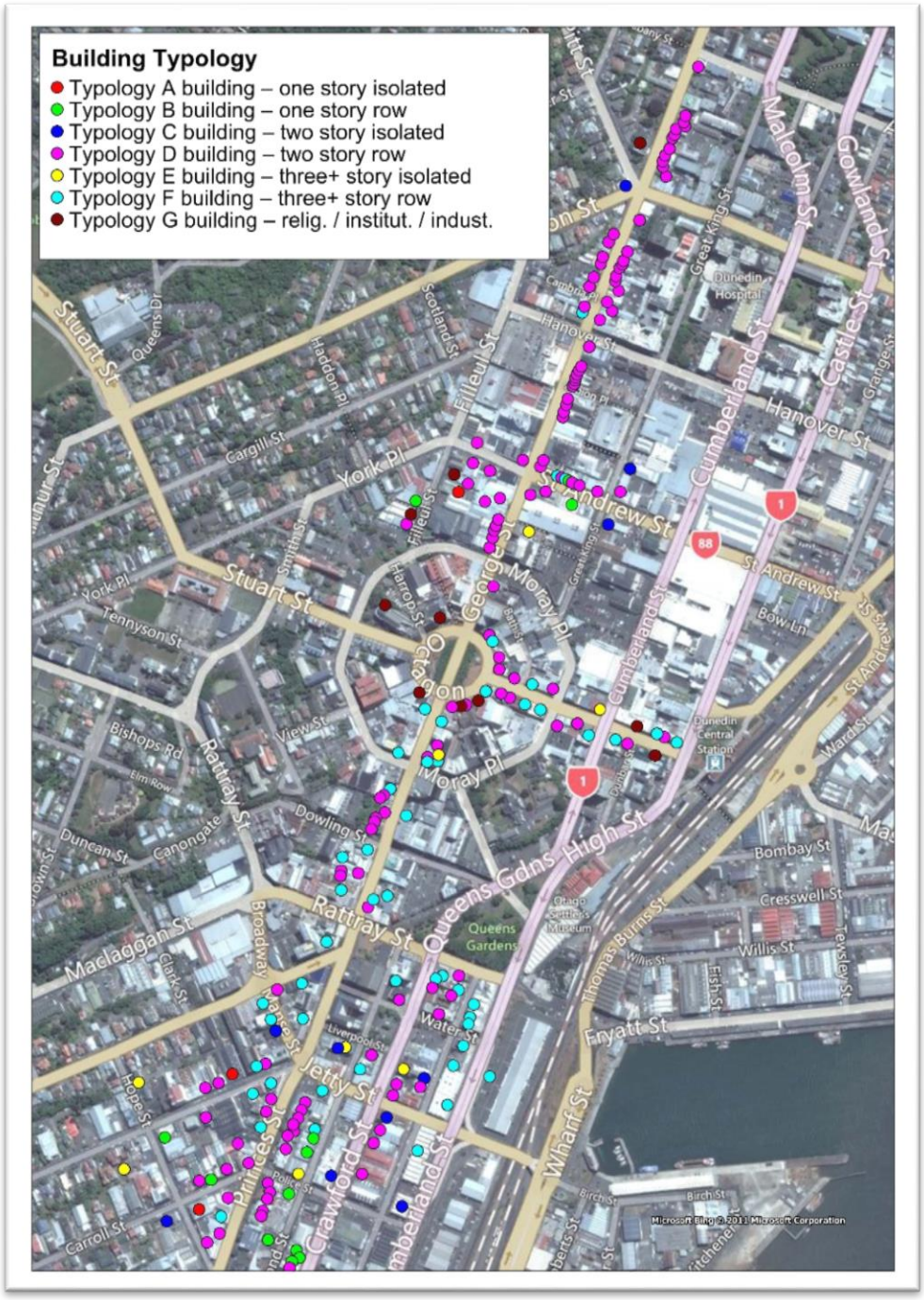

Figure 4: Selected samples in Dunedin.

FINDINGS

The study started with an analysis of demographics of the respondents. It was followed by a descriptive analysis of the two datasets collected.

Respondents Profile and Business Characteristics

Almost 51% of the respondents in Napier and 57% in Dunedin were business owners. The designation of other participants comprised of the business director (11% in Napier and 13% in Dunedin), business manager (40% in Napier and 28% in Dunedin), department manager (4% in Napier and none in Dunedin), and employee (4% in Napier and 2% in Dunedin). About 50% of the respondents in each region had less than ten years of experience in their current sector. Most of the respondents in Napier were in their 50s and Dunedin in their 40s. Ethnicity-wise, most of the respondents could be categorised as the New Zealand Europeans (94% in Napier and 89% in Dunedin). Therefore, the majority of the respondents could be depicted as middle-age business owners that were operating their businesses for more than ten years. These demographics suggest that the participants have been able to provide reliable information.

Similar demographics analysis was conducted to define the organisational characteristics of the participants. It was found that 78% of the participants in Napier and 75% in Dunedin reported working in retail trade and hospitality sector, while the remaining respondents included professional services such as finance, insurance and real estate, health and legal services. A majority of the organisations had less than five full-time employees. About 50% of the businesses in both regions were reported to have been operating for fewer than 20 years in Napier and 15 years in Dunedin. Close to 80% of the businesses in Napier and 87% in Dunedin are locally owned and were

located in a separate business location from the respondents' home (90%). Thus, the analysis portrayed the business characteristics of the majority of respondents as being involved in retail trade and hospitality sector with less than five full-time employees (SMEs) and an operational age of fewer than 20 years. The organisational characteristics suggest that the sample corresponds to the larger population of the characteristic(s) of interest and the research findings can be generalised. In this study, the research findings and conclusion from the sample are probably applicable to the entire population of SMEs operating within the retail sector in suburban towns.

Descriptive Analyses and Comparison

Descriptive statistical analyses were conducted to explore the preparedness actions adopted by the SMEs in the two regions of the survey. This analysis enabled a comparison of the adoption trends within and between each of the four broad categories provided in Table 1. The analysis involved the calculations of the mean value that measured central tendency by identifying the central position of the datasets. The results of the in-group comparison are summarised in Figure 25.

As shown in Figure 5, in *Knowledge enrichment activities (*category 1), a majority of the respondents had already discussed the actions to be taken in the event of an earthquake with their employees (70% in Napier and 76% in Dunedin). Nearly, 39% of SMEs in Napier and half of them in Dunedin had also attended a first aid course. This result could be attributed to the requirements of Public Act No 70 [83] that mandates the employers to have a certain number of employees trained in first aid. The least adoption rate in this category belonged to the provision of support for other disaster-related training programs for employees with a rate of 4% in Napier and 10% in Dunedin. Chikoto, et al. [57] reported an adoption rate of 30.6% of the similar preparedness action for private organisations in the United States, which indicates a major gap when compared to New Zealand.

In the second category of the preparedness actions, *Insurance and Business Continuity Plans*, a majority of SMEs had purchased business contents insurance (82% in Napier and 91% in Dunedin). A substantial share of the SMEs had also obtained business interruption insurance (75% and 76% in Napier and Dunedin, respectively). Studies on preparedness actions have linked such a high level of adoption of insurance purchases to the social norm of *moral hazard* [12,84]. Insurance purchase could be a sign of disincentivisation to guard against actual adoption of risk mitigation measures [85-87]. In this group, the least attention was paid to the development of the business disaster recovery and emergency plans. The scored rate was about 11% in Napier and 20% in Dunedin. Similar results relating to a lack of interest to adopt business disaster recovery and emergency plans were also reported among business owners in the U.S. [88]. This lack of interest could be linked to the size of the organisation, which imposes resource scarcity, both in finance and the number of staff, to be devoted to planning for mitigating the potential earthquake risk [88-90].

In the third category, *Business Disaster Survival Actions*, about 86% of the SMEs in Napier and almost 90% of them in Dunedin reported having a first aid kit or extra medical supplies available. Given the low cost of implementing this action, along with the requirements set out by the Department of Labour [91] which stipulated that each workplace should suitably stock first aid kit, this high percentage comes as no surprise. On the contrary, none of SMEs in Napier and about 25% of them in Dunedin had obtained an emergency generator. As McClure, et al. [68] suggested, the lack of purchase of an emergency generator may not be only because of its high cost, but other attributes such as fatalism or priority accorded to the mitigation action. It is possible that the respondents accorded a low priority to the purchase of an emergency generator due to no prior experience with power outages within the region. Another possible explanation relates to fatalism, which refers to the acceptance of inevitability and indocility of natural disasters that mitigation actions would make no difference towards enhancing disaster resilience [92]. It implies that the causes of damage in a disaster event can be attributed to the force of the earthquake alone rather than other controllable factors such as seismic retrofitting of vulnerable buildings and adopting preparedness measures.

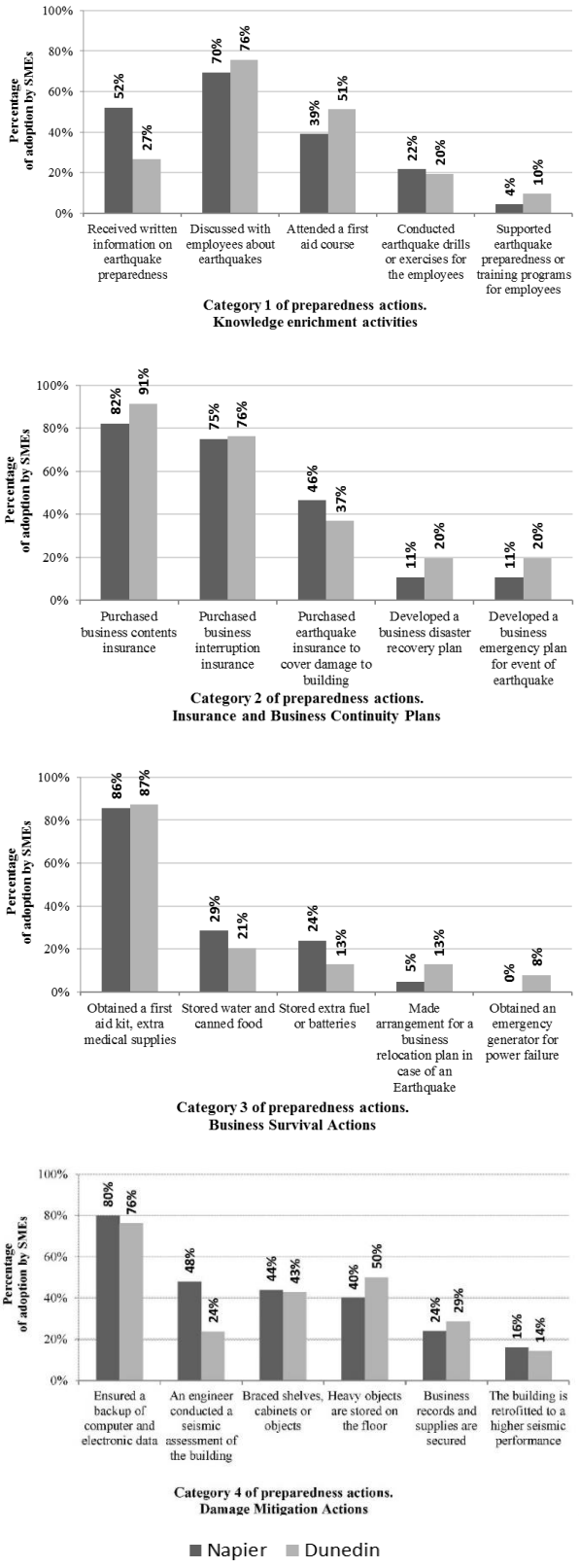

Figure 5: In-group patterns of adoption of preparedness actions in Napier and Dunedin.

Significant fatalistic mind-sets with a positive correlation with the age of the respondents (over 40 years) have been reported among New Zealanders [93]. As discussed in the previous section, the majority of respondents in this study were older than 40 years of age. Similar findings have also been reported by McClure, et al. [68]. Other actions in this group including the securing of supplies of water, food and fuel in store, and the design of a relocation plan consistently stayed below 30%. This situation implies a poor preparation for an emergency in case of a potential earthquake in these two regions.

In the fourth category, *Damage Mitigation Actions*, securing or backup of the electronic data demonstrated the highest adoption rate (80% in Napier and 76% in Dunedin). The low cost and ease of adoption of these this mitigation action could be attributed to their adoption rate. The lowest rate was recorded for the retrofitting of the building to a higher seismic performance (8% in Napier and 14% in Dunedin). The retrofitting of the building to a higher seismic performance refers to mitigation action that the property owner might undertake to reduce the physical vulnerability of the structure to disaster damage caused by the earthquake. According to McClure, et al. [68], a significant share of the businesses does not own their premises, which gives them restricted control over the owners' initiatives to take preparedness actions, consequently. The adoption rate of other actions in this group stayed in a range between 24% and 50%.

Between-group Adoption Patterns for Preparedness Actions in Napier and Dunedin

A descriptive analysis of the data collected enabled a comparison between the patterns, followed by a test of the statistical significance of the observed differences. As shown in Figure 6, the two regions show slightly different adoption patterns for mitigation actions in categories 1, 3 and 4. SMEs in Napier demonstrated a slightly higher average adoption rate compared to Dunedin. These higher results are expected because Napier is categorised as a high seismic zone being in proximity to fault lines (hazard source). Proximity to fault lines can be perceived as a potential risk when people make decisions to adopt preparedness actions [19]. This finding suggests that the extent to which people know and acknowledge the proximity of their residence to a source of hazard, and the understanding of the correlation between this proximity and their vulnerability to earthquake disaster would affect the adopted preparedness actions. It is also possible that the active mitigation approach adopted the Napier city council has promoted the critical awareness of seismic risks in the community, consequently facilitating positive changes to people 's perception of risks and the adoption of mitigation measures. Critical awareness refers to the extent of thought, discussion and information receipt about earthquake risk mitigation on a regular basis, which raises personal concern about earthquake hazard [94]. It is worthy to note that the critical awareness measures that examine the impacts of specific risk communication messages on mitigation actions were included in the questionnaire so that it is not possible to draw specific conclusions about the importance of extent of thought, discussion and information receipt. However, for the preparedness actions listed under category 2 (insurance and business continuity plan), Dunedin reported a 3.8% higher adoption rate than Napier. The slight difference in the adoption rate for category 2 for Dunedin could be related to the higher number of businesses operating in Dunedin than Napier (see Table 2). Despite not being directly reported in the literature, and not being legally required by regulation, the purchase of business insurance and the development of business continuity planning (BCP) in New Zealand are likely to be undertaken by business owners who have a finance loan obligation for their business. Financial institutions often mandate insurance purchase to protect their investment. Currently, various business insurance providers and brokers offer BCP has a combined package.

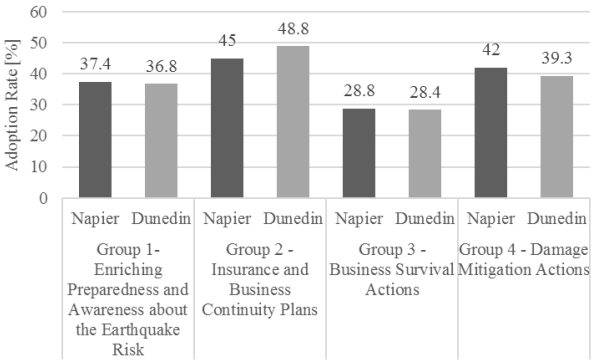

Figure 6: A comparison between Napier and Dunedin in adoption rate within each broad category.

In order to evaluate the overall preparedness level of SMEs for a potential earthquake, the level of statistical significance of the observed difference in the adoption rate in the two regions of the study was examined. The examination of the level of statistical significance is important because the two samples surveyed in this study were taken from different populations (i.e. two regions having varying level of seismicity). The statistical significance of the difference was assessed using an independent sample t-test. The test compares the means of two independent groups in order to determine whether there is statistical evidence that the associated population means are significantly different [95]. To conduct the t-test, $t_{statistics}$ and the degrees of freedom using individual variances were approximated. The null hypothesis of two-sample t-test for independent data was defined as $H_0: \mu_1 = \mu_2$, where μ denoted the population mean. Further, based on Welch [96], the test statistic was defined as $t = (m_1 - m_2)/(S_1^2/N_1 + S_2^2/N_2)^{0.5}$; where N_1 and N_2 were the sample sizes, m_2 and m_2 were the samples means, and s_1^2 and s_2^2 were the sample variances. This $t_{statistic}$ was compared against a two-tail critical value of the t distribution with $\nu = N_1 + N_2 - 2$ degrees of freedom and a significance level of $\alpha = 0.05$. The result of the t-test is summarised in Table 3.

As shown in Table 3, the values of $t_{statistic}$ were significantly lower than $t_{Critical}$. Accordingly, the two samples could be inferred to have similar statistical properties. Therefore, the data from both regions could be combined to examine the overall preparedness actions adopted by SMEs. This finding is in-line with the results of a similar study conducted by Lindell and Prater [32] in the U.S. They examined the mitigation and preparedness activities in Southern California that has a high seismic hazard, and Western Washington as a low seismic hazard area. The authors found non-significant differences in the majority of self-reported preparedness actions in the two regions, despite the different levels of seismic vulnerability in the two regions.

Table 3: T-test results to evaluate the level of similarity between the two populations.

Broad Group Number	Region	m	s^2	v	t_{Stat}	$t_{Critical}$	P-Value
Group 1- Preparedness and Awareness about the Earthquake Risk	Napier Dunedin	36.80 37.40	708.70 657.80	8.00	-0.04	2.31	0.97
Group 2 - Insurance and Business Continuity Plans	Napier Dunedin	48.80 45.00	1079.70 1145.50	8.00	0.18	2.31	0.86
Group 3 - Business Survival Actions	Napier Dunedin	28.40 28.80	1094.80 1172.70	8.00	-0.02	2.31	0.99
Group 4 - Damage Mitigation Actions	Napier Dunedin	39.33 42.00	491.07 497.60	10.00	-0.21	2.23	0.84

Overall Preparedness of SMEs

The dataset was combined to investigate the overall number of preparedness actions adopted by the respondents. The results are summarised in Figure 7. The responses were grouped into four score intervals specified as 0-5 (underprepared), 6-10 (somewhat prepared), 11-16 (prepared), and 17-21 (highly prepared). As illustrated in Figure 7, the percentage of SMEs in the underprepared group that had adopted less than five mitigation actions was close to 50%. The situation seems even more critical knowing that almost 70% of the enterprises have had in place less than 10 actions. The low number of preparation actions reported could be attributed to a number of reason such as business characteristics, financial capacity and perceived vulnerabilities. The overall picture presented in this study still suggests that business owners may not be adequately preparing their businesses for potential external threats, which requires close consideration from all stakeholders associated with disaster resilience of SMEs.

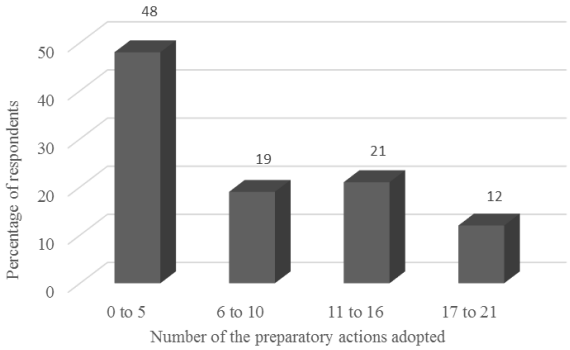

Figure 7: The overall preparedness level.

IMPLICATIONS AND RECOMMENDATIONS

The research findings showed that despite the occurrence of major earthquake disasters in New Zealand, SMEs in the two regions of study are underprepared for a potential earthquake disaster. The researchers expected prior experience with natural disasters such as earthquake events would result into a higher level of risk mitigation planning and adoption of preparedness actions, although pre-existing conditions that influence the current level of preparedness were not examined in this paper. The findings also showed that participants in both regions displayed similar characteristics with specific types of preparedness actions such as business insurance, emergency survival actions and structural mitigation of building, regardless of their proximity to the hazard source. Insurance-related mitigation actions are popular among the respondents. These policies are initiated to transfer the risk of income loss and to physically protect business assets that may include inventories, supplies, equipment and records. Overreliance on insurance mitigation action, however, often leads to a moral hazard scenario, which causes a lack of motivation for undertaking additional actions to guard against the earthquake disaster risks, as well as decreasing the overall operational reliability of other preparedness actions [86]. The adoption of insurance-related mitigation actions would, therefore, reduce the likelihood of their accepting the need to prepare, the attribution of responsibility for protection from earthquakes to insurance providers and the expectation of financial bail-outs or disaster aids. It is possible that the SMEs who participated in the study fail to adopt preparedness actions due to perceived non-responsibility and attitudes regarding the efficacy of the mitigation actions. According to Paton [97], perceived responsibility is governed by cognitive and attitudinal processes, and is particularly important to predict people's behavioural intentions to adopt hazard mitigation adoption. This research finding thus calls for immediate action towards approaches that target changing the risk mitigation behavioural of SMEs. According to Martin, et al. [98], such approaches should include increasing people's subjective knowledge and changing the perceived responsibility of individuals. Subjective knowledge alters the individual perception of risk through the use of a hierarchical organisation of disaster communications and dynamic social interactions. [98]. In New Zealand, improving hazard risk communication between the local authority, building owners, and business owners will help to boost the efficiency of knowledge dissemination, while overcoming procedural issues. Further research is needed to examine how the concept of subjective knowledge can be used in a social adaptive way to understand how mitigation adoption attitudes are initialised and sustained, and how they can be enhanced to facilitate the adoption of preparedness measures, particularly in the New Zealand SMEs context. Also, further research is needed to examine the way this business hazard related insurance policies are structured, which is likely to cause a moral hazard problem.

Furthermore, the research findings showed that business survival actions such as obtaining a first aid kit, extra medical supplies, storing water and canned food, generators and storing extra fuel or batteries, were readily adopted by SMEs. These strategies are often employed for emergencies. This finding agrees with the previous work by McClure, et al. [68]. The authors found that People who prepare for earthquakes complete more emergency survival actions (e.g., get water supplies) than structural damage mitigation actions. One might speculate that the adoption rate of this category of actions was high because of the associated low cost and less complexity in their implementation, as well as regulatory compliance practice for businesses. This association is particularly important for SMEs because they must commit their financial resources to other threats and opportunities to survive the competition. Under the Health and Safety in Employment Act 1992 and its amendments in 2016, there is a requirement for businesses to be able to look after their staff during an emergency; this includes providing first aid kit, and extra medical supplies.

Legislation could also be a strong motivator in this scenario. However, it enforces compliance with the minimum requirements that may not directly affect the adoption rate. According to Comerio [99], hazard mitigation policies should be used to expand and not limit the ways that businesses and public institutions meet and exceed basic safety requirement. Overall, the research findings suggested businesses in the regions studied are generally underprepared for another major earthquake, and that SMEs are selective about the mitigation actions adopted. The investigation of the SMEs preparedness actions provides information on the nature, types and adoption patterns of these SMEs. It is important to note that quantity or adoption rates should not be used as a yardstick to measure the appropriateness of preparedness actions because of other factors such as risk perception, ownership, type of business type and sector, location, size and financial capacity of their businesses that may interact to influence the decision.

CONCLUSION AND RECOMMENDATIONS

A study was conducted in order to examine the characteristics and the level of preparedness of New Zealand businesses against a potential earthquake disaster. It focused on SMEs in two suburban locations with different vulnerability levels to seismic hazard. The SMEs demonstrated a clear tendency towards adopting readily available, less costly and easy to implement initiatives. The adoption rate was, however, alarmingly low. The study revealed that a majority of SMEs had undertaken less than five preparedness actions out of the twenty-one potential initiatives. This level of unpreparedness calls for an urgent action to prevent any major economic disruption in case of an earthquake in the future. Accordingly, specific strategies should be developed with the aim of enhancing the risk mitigation behaviour of SMEs. The findings provide essential knowledge to inform future earthquake resilience policy and practice. Further studies are required to increase the level of confidence in the results, as well as indicating a higher number of alternative strategies to promote adoption of preparedness actions by SMEs.

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