

Earthquake Impacts, Organizational Resilience and Recovery of the Accommodation/Food Services Sector in Canterbury, New Zealand: A Comparative Assessment

Abstract

The purpose of this study is to analyse the felt earthquake impacts, resilience and recovery of organizations in Canterbury by comparing three business sectors (accommodation/food services, Education/Training and Manufacturing). A survey of the three sectors in 2013 of Canterbury organizations impacted by the earthquakes revealed significant differences between the three sectors on felt earthquake impacts and resilience. On recovery and mitigation factors, the accommodation/food services sector is not significantly different from the other two sectors. Overall, the survey results presented here indicate that the Accommodation/Food Services sector was the least impacted by the earthquakes in comparison to the Education/Training and Manufacturing sectors. Implications for post-disaster management and recovery of the accommodation sector are suggested.

Keywords: organizational resilience, disaster recovery, accommodation, earthquake impacts, mitigation factors, industry sectors

Introduction

Business sector is a significant predictor of both impact and recovery from disasters (Webb et al., 2002; Brown et al., 2014). The felt impacts of earthquakes on organizations can take the form of direct physical damages and utility disruption (Brown et al., 2014). This paper presents findings from a comparative analysis of felt earthquake impacts, mitigation, organizational resilience and recovery of three important business sectors in the region of Canterbury namely, accommodation/food services, education/training and manufacturing. The Canterbury region was affected by a series of damaging earthquakes in 2010 and 2011. The earthquakes resulted in extensive damage to buildings and land. Together these earthquakes were by far the most expensive and socially disruptive disaster that New Zealand has ever experienced (Stevenson et al., 2014).

The accommodation sector underpins tourism activity in Christchurch and contributes around two percent of GDP for the region (CDC, 2015). The Sept 2010 and Feb 2011 earthquakes had a significant impact on this sector and related tourism activities leading to reduced visitor numbers and damage to built infrastructure. Hotels and backpackers in the central business district, for example, were the worst affected. Formal planning for disasters was found to be limited in extent, with many providers relying on their ability to react and respond to the events as they happened (Orchiston et al., 2014). Of existing studies (Mannakkara & Wilkinson, 2014; Whitman et al., 2013) that attempt to understand the factors that influence the impact, mitigation and recovery of organizations in a post-disaster context, the tourism and hospitality industries remain under-researched (Orchiston et al., 2014).

The effects of earthquakes on the physical and social environments are well documented in the disaster literature but how organizations respond to, adapt and recover post-disaster are poorly understood (Halvorson & Hamilton, 2010). There is a need to understand how different sectors are affected by disasters and the factors that influence recovery (Galbraith & Stiles, 2006). For example, business sector, business size and age are significant predictors of success and survival post-disaster (Dahlhamer & Tierney, 1998) in some studies but not in others (e.g. Brown et al., 2014). Hence, understanding differences across sectors on disaster mitigation, organizational resilience and recovery strategies may help in organizational

planning and preparedness for disasters. To this effect, the main objective of this study is to compare the accommodation/food services sector with the manufacturing and education/training sectors on key issues associated with post-quake organizational recovery. The manufacturing sector was chosen because of its importance to the Canterbury region, being the second largest manufacturing centre in New Zealand and contributing 12% to GDP of Christchurch (CDC, 2015). The education/training sector has the second largest growth rate in international education in NZ since the earthquakes and contributes five percent to GDP of Christchurch. Education tourism is purported as a future growth sector in the region (CDC, 2015).

Literature Review

Felt Impacts of Earthquakes and Recovery

The literature on organizational earthquake vulnerability and impacts suggests that several factors account for organizational impact and survival in a post disaster context. Earthquake impacts on organizations in particular can take the form of direct physical damages to structures and property, inventory, non-structural damages to premises, service interruptions, changes in cash flow, halted or slowed production, changes in suppliers and customers, staff attrition and psychosocial effects on staff and family (Corey & Deitch, 2011; Kroll et al., 1991; Orchiston et al., 2012; Tierney, 1997; Webb et al., 2002; Wasileski et al., 2011; Whitman et al., 2013). Utility disruption in particular can lead to significant financial losses (Tierney, 1997; Webb et al., 2000) and reduced productivity (Wasileski et al., 2011). For example, disruption to the transport network can limit customer and supplier access to premises (Tierney, 1997). Following the 2010/2011 Canterbury earthquakes, Brown et al. (2014) found that “customer issues” impacts were the most disruptive for organizations. The disruption of critical services and organizational size are symbiotic with sector-specific organizational vulnerabilities (Whitman et al., 2013). Of the hospitality businesses surveyed, Kachali et al. (2012) found that 78% reported the need to use new suppliers.

Industry sectors tend to respond differently to earthquake effects (Tierney, 1997; Webb et al., 2002). Wholesale and retail businesses generally report experiencing significant sale losses, relatively high failure rates and slower rates of recovery (Kroll et al., 1991). In contrast, large disasters can stimulate activity and growth for manufacturing and construction sectors (Webb et al., 2002). Recovery from a disaster is a complex and interconnected process, and not always a guaranteed outcome for affected organizations (Kachali et al., 2012). Organizational recovery in a post-disaster context is dependent on several factors including industry-sector vulnerabilities (Webb et al., 2002; Whitman et al., 2013), neighbourhood effects (e.g. damage to nearby organizations and customers’ perceptions of an area’s damage state (Dahlhamer & Tierney, 1996). The relationship between industry sector and recovery is not consistent across all disasters or throughout the recovery period (Brown et al., 2014). Given that organizations work in an increasingly interdependent environment, it is necessary to understand organizational recovery from a systems dynamic perspective. Decisions made by one organization in the immediate aftermath of a disaster can influence the recovery of other organizations (Corey & Dietch, 2011).

Mitigating Earthquake Impacts on Organizations

The literature on mitigation strategies used to limit earthquake impacts and boost recovery can at best be described as contradictory. For example, the majority of sectors surveyed post Darfield earthquake of 2010 mentioned that well designed and well-built buildings and relationship with staff were the most important factors limiting disruption (Whitman et al.,

2013). Also, large organizations were more likely to use business continuity plans in mitigating organizational disruption than smaller organizations. Corey and Deitch (2011) found that the education sector experienced the most severe dip in performance following Hurricane Katrina but construction sector recovered the best. Whitman et al. (2013) found that farming organizations suggested “relationship with neighbours” and “insurance” to be the most important factors mitigating earthquake impacts but non-farming organizations suggested financing options and supply chain logistics as being the most helpful. Thus, sectorial differences may exist on the importance and helpfulness of mitigation factors in limiting disruption to business operations and recovery (Whitman et al., 2013).

Organizational Resilience

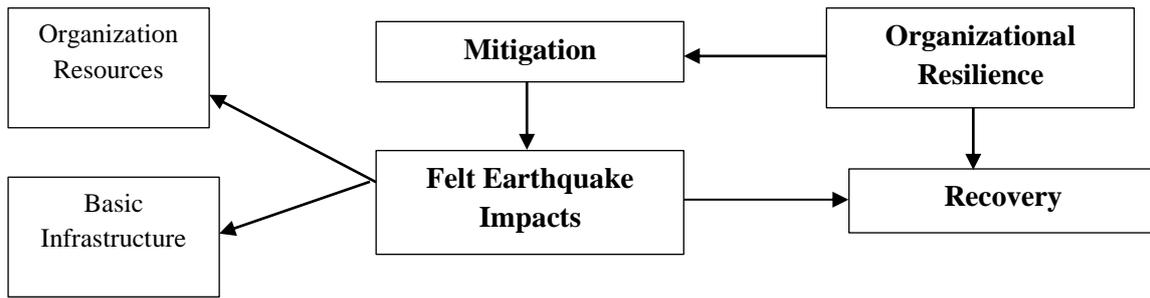
Resilience has been defined in many ways in different fields. Resilience generally refers to the ability of a system to maintain and adapt its essential structure and function in the face of disturbance while maintaining its identity (Holling, 1973). Resilience has emerged as an important concept in the tourism industry (Biggs et al., 2012; Strickland-Munro et al., 2010). Tourism resilience has been defined as “the ability of social, economic or ecological systems to recover from tourism induced stress” (Tyrrell & Johnston, 2008, p.16). The majority of tourism studies focus on ecological/environmental resilience of tourism systems, except for the study of Biggs et al. (2012) on resilience of formal and informal tourism enterprises to disasters. A resilient tourism enterprise is “one that is able to remain in a stable state, maintaining or growing its income and employee numbers despite disturbance” (Biggs et al., 2012, p.647).

Akin to the concept of enterprise resilience, organizational resilience has emerged as an important concept in the organizational behaviour and disaster management literatures. Organizational resilience refers to the capacity of the organization to adapt to disturbances and seize opportunities emerging from the changed environment (Smit & Wandel, 2006). The organization’s adaptive capacity is an integral constituent of organizational resilience (Smit & Wandel, 2006). Some organizations are more adaptive than others post-disaster (McManus et al., 2008). Hence, an emerging research strand links organization resilience to business recovery (Chang et al., 2001). This body of research suggests that resilience consists of two dimensions, planned and adaptive. Planned resilience involves the use of existing, predetermined planning and capabilities, as exemplified in business continuity and risk management which are predominantly pre-disaster activities. Adaptive resilience emerges during the post-disaster phase as organizations develop new capabilities through dynamically responding to emergent situations that are outside of their plans (Lee et al., 2013). The hospitality sector in Canterbury had the highest number of organizations agreeing that their planning for the unexpected is appropriate, suggesting adequate planned resilience (Kachali et al., 2012).

The Theoretical Model

Disaster management is commonly represented by four phases: mitigation, preparedness, response and recovery (Rubin, 1991). In this study, we developed a theoretical model (Figure 1) to explain recovery of organizations in a post-quake environment based on existing disaster management principles (Faulkner & Vikulov, 2001; Rubin, 1991). The model suggests that organization recovery can be explained partly by organizational resilience and felt earthquake impacts on organizations resources and basic infrastructure. The mitigation strategies put in place by organizations are dependent on resilience, which can also contribute to explain felt earthquake impacts and recovery.

Figure 1: Theoretical Framework



Method

Survey Instrument

The paper is based on survey data on business behaviours, resilience and recovery following the 2010/2011 Canterbury earthquakes. The data were collected as part of a larger project by Resilient Organizations aimed at quantifying the economic implications of vulnerabilities to infrastructure. The survey instrument was built from previous studies on impacts of earthquakes on organizations in New Zealand and elsewhere. Earthquake impacts on organizations were measured using 16 items adapted from the literature (Brown et al., 2014; Kachali et al., 2012; Powel, 2010), on a four-point likert scale (0=*Not Disruptive* and 3=*Very Disruptive*). Seventeen items that helped organizations mitigate the impact of the earthquakes were borrowed from the literature (Whitman et al., 2013) and measured on a four-point likert scale (0=*Not Important* and 3=*Very Important*). The extent of disruption caused by the earthquakes on 11 critical basic infrastructures were borrowed from the literature (Wasileski et al., 2011; Whitman et al., 2013) and measured on a four-point likert scale (0=*Not Disruptive* and 3=*Very Disruptive*). Recapturing lost production/delivery/output as part of the recovery strategy was measured using 5 items on a four-point likert scale (0=*Not Important* and 3=*Very Important*). Organizational resilience was measured on eight-point likert scale, anchored on “.00”-*Strongly Disagree* and “1.00”- *Strongly Agree* using 13 items adapted from the literature (Kachali et al., 2012). Demographics such as age and size of the organization (Dahlhamer & Tierney, 1998), Māori status, and property ownership were also measured (Brown et al., 2014).

Sampling and Data Collection

The database used to identify the sampling frame of organizations in the region of Canterbury was obtained from a business-to-business marketing company and was divided by sector. Two sampling criteria were used to include companies in the sample: (i) organizations must have premises in one of the three districts in the Canterbury region that were directly impacted from the 2010/2011 earthquakes; (ii) the organizations must be classified under the Australian and New Zealand Standard Industrial Classification (ANZSIC). Organizations were initially contacted by telephone and the respondents had the option of completing the survey either over the telephone, online or a hard copy was sent. The data were collected between July-December 2013. From an initial 2176 organizations contacted, 541 complete and valid surveys were obtained. Of these, 154 were included in this study (45 representing the accommodation sector, 74 representing the manufacturing sector, and 35 representing the Education/Training sector). The sample was proportionally representative of organizations in these three sectors in the Canterbury region.

Findings

Sample Description

The average age of the organizations participating in this study was 34 years old with an average of 32.7 full time employees in the Canterbury region. On average, no significant differences existed between the three sectors on the number of full time employees in the Canterbury region ($F=1.421$, $p>0.05$). However, a significant difference existed on the average age of the organizations ($F=18.20$, $p<0.001$), whereby organizations in the Accommodation/Food service sectors ($M=19.9$) and Manufacturing ($M=32$) were comparatively younger than those in the Education/Training sector ($M=57.6$).

Felt Earthquakes Impacts on Organization Resources

Analysis of variance (ANOVA) with Hochberg's post-hoc comparisons on the three sectors revealed significant differences on 7 of the 16 earthquake impact items (Table 1).

Table 1: Earthquake Impacts on Organizational Resources

Earthquake Organizational Impacts	Sectors	N	Mean	Std. Dev	F	Sig.
Difficulty accessing IT data	Education and Training	35	1.54	1.094	8.263	0.000*
	Manufacturing	68	0.99	1.086		
	Accommodation and Food Services	37	0.57	0.801		
Difficulty accessing premises / site	Education and Training	33	1.30	1.262	5.388	0.006*
	Manufacturing	60	0.80	1.038		
	Accommodation and Food Services	40	0.48	0.96		
Health and safety issues for employees	Education and Training	32	1.47	1.047	11.732	0.000*
	Manufacturing	65	0.91	0.98		
	Accommodation and Food Services	37	0.41	0.599		
Supplier Issues	Education and Training	26	1.04	0.916	3.502	0.033**
	Manufacturing	70	1.19	0.921		
	Accommodation and Food Services	39	0.72	0.793		
Customer issues	Education and Training	31	1.77	1.055	3.453	0.034**
	Manufacturing	70	1.44	1.085		
	Accommodation and Food Services	43	1.12	1.051		
Perceptions of building safety	Education and Training	34	1.47	0.961	4.114	0.018**
	Manufacturing	67	1.16	1.053		
	Accommodation and Food Services	37	0.81	0.811		
Changes in staff emotional well being	Education and Training	35	2.00	0.907	13.38	0.000*
	Manufacturing	66	1.53	0.98		
	Accommodation and Food Services	41	0.88	0.954		

*significant at the $p<0.01$ level, ** significant at the $p<0.05$ level

On average, the earthquake impacts were less disruptive on the Accommodation/Food Service sector ($M=0.57$) on accessing IT data compared to the Education/Training ($M=0.99$) and Manufacturing sectors ($M=1.54$). A significant difference also existed on difficulty in accessing premises whereby disruptions were lower for the Accommodation/Food Service sector ($M=0.48$) in comparison to the Education/Training ($M=1.3$) sector. The impact on customers and suppliers was significantly different between the Education/Training ($M=1.77$; $M=1.12$) and Accommodation/Food Service ($M=1.04$; $M=0.72$) sectors as well. Overall, the Accommodation/Food Service sector was impacted less compared to the Manufacturing and Education/Training sectors.

Felt Earthquake Impacts on Organizations Basic Infrastructure

Following a similar procedure as before (ANOVA and post-hoc comparisons), significant differences were identified between the three sectors on impacts of the earthquake on the organization's four basic infrastructures (gas, data networks, road networks, and airport). On average, the earthquake impacts on gas was more disruptive for the Accommodation/Food service sector ($M=0.66$) compared to Manufacturing ($M=0.22$) and Education/Training ($M=0.12$) sectors (Table 2). On data networks, a significant difference existed between only the Education/Training and Accommodation/Food service sectors. The former ($M=1.63$) was more heavily disrupted than the latter ($M=0.82$) on data networks (Table 2). A similar finding emerged on road networks for the two aforementioned sectors. However, the Accommodation/Food Services sector was more heavily disrupted ($M=0.78$) than the Education/Training sector ($M=0.12$) on airport.

Table 2: Earthquake Impacts on Organizations' Basic Infrastructure

Impacts on Basic Infrastructure	Sectors	N	Mean	Std. Dev.	F	Sig.
Gas	Education and Training	33	0.12	0.55	5.808	0.004*
	Manufacturing	69	0.22	0.68		
	Accommodation and Food Services	44	0.66	1.03		
Data networks	Education and Training	35	1.63	0.94	6.539	0.002*
	Manufacturing	74	1.15	1.06		
	Accommodation and Food Services	45	0.82	0.91		
Road networks	Education and Training	34	1.65	1.01	6.363	0.002*
	Manufacturing	74	1.3	1.00		
	Accommodation and Food Services	45	0.82	1.11		
Airport	Education and Training	33	0.12	0.42	12.748	0.000*
	Manufacturing	74	0.22	0.58		
	Accommodation and Food Services	45	0.78	0.90		
*significant at the $p<0.01$ level						

Mitigation of Earthquake Impacts

Organizations were asked the importance of several factors in helping them to mitigate the impacts of the earthquakes. ANOVA results with post-hoc comparisons indicated that significant differences existed between the three sectors on only three factors (Table 3). On average, relationship with staff as a mitigation factor was the least important for the Accommodation/Food Services sector (M=2.15) compared to the Education/Training sector (M=2.76). However, practiced response to a disaster as a mitigation factor was more important to the Education/Training sector (M=2.12) than the Manufacturing sector (M=1.34). A similar result was also evident between the two aforementioned sectors on emergency kit as a mitigation factor. Overall, the Accommodation/Food Services sector was on par with the other two sectors on mitigation factors.

Table 3: Mitigation Strategies of Organizations

Mitigation	Sectors	N	mean	Std. Dev.	F	Sig.
Relationship with staff	Education and Training	33	2.76	0.50	6.012	0.003**
	Manufacturing	66	2.59	0.76		
	Accommodation and Food Services	39	2.15	0.99		
Practiced response to a disaster	Education and Training	33	2.12	1.17	5.403	0.006**
	Manufacturing	61	1.34	1.03		
	Accommodation and Food Services	34	1.53	1.16		
Emergency kit	Education and Training	31	2.10	1.22	7.147	0.001**
	Manufacturing	60	1.20	0.97		
	Accommodation and Food Services	37	1.68	1.18		
** significant at the p<0.01 level						

Organizational Resilience

The 13 items of organizational resilience were factor-analysed (Table 4).

Table 4: Organizational Resilience

Resilience Items	Planning Resilience	Adaptive Resilience	Communalities
We have a focus on being able to respond...	0.851	0.191	0.761
Our organisation is committed to practicing...	0.840	0.140	0.725
We build relationships with others...	0.793	0.159	0.655
We have clearly defined priorities ...	0.778	0.268	0.677
Given how other depend on us...	0.693	0.287	0.563
We proactively monitor our industry...	0.618	0.339	0.497
There would be good leadership...	0.108	0.851	0.736
People in our organisation are committed resolving problems...	0.159	0.765	0.610
If key people are unavailable...	0.146	0.690	0.497
We can make tough decisions quickly	0.380	0.685	0.613
Our organisation maintains sufficient resources...	0.190	0.669	0.484
We are known for our ability to use knowledge...	0.356	0.532	0.410

There are few barriers stopping us...	0.239	0.526	0.334
Eigenvalue	3.950	3.611	
% of variance explained	30.388	27.779	
Cronbach's alpha	0.886	0.824	

Prior to this the usual KMO statistic and Bartlett's test of sphericity were estimated and the results confirm the suitability of the data for factorization. Two factors were extracted, explaining 58.2% of total variance. The two factors reflected the dimensions of planning resilience and adaptive resilience. Both factors had Cronbach's alpha >0.7 (Hair et al., 2006) indicative of internal consistency and reliability. Composite measures were created prior to analysing whether the three sectors were significantly different on these two factors.

The results confirmed that all three sectors were significantly different on the two factors. On average, the Education/Training sector (M=0.84) was more agreeable than Manufacturing (M=0.69) and Accommodation/Food Services (M=0.72) that their organizations were resilient on planning. The Accommodation/Food Services sector (M=0.76) displayed on average lower agreement than the Education/Training sector (M=0.85) on adaptive resilience.

Post-Quake Recovery of Organizations – Recapturing Lost Production/Delivery/Output

The five items (greater use of staffing resources, high levels of inventory, conservation of resources, intensive use of existing resources and replaced/upgraded technology) as part of post-quake recovery strategies were analysed by sector. ANOVA with post-hoc comparisons revealed that the three sectors were not statistically different on importance attached to these items, except for the manufacturing (M=1.0) and education/training (M=0.48) sectors on high levels of inventory (F=3.71, p<0.05).

Discussion and Implications

The main objective of this study was to compare the Accommodation/Food Services sector with Manufacturing and Education/Training sectors on felt impacts, mitigation, organizational resilience and recovery following the Canterbury earthquakes. Similar to other studies (Whitman et al., 2013) sectorial differences were found on several earthquake impacts and organizational resilience. The Accommodation/Food Services sector was the least impacted in comparison to the other two sectors. By using staffing resources, conserving and more intensive use of existing resources, and technology the three sectors have been able to recapture lost production. From a sector vulnerability perspective, the recovery of the three sectors is on par despite significant differences in felt impacts, despite the accommodation sector being the most impacted by disruptions in critical infrastructures of airport and gas.

The results provide opportunities for other sectors in NZ to understand and learn about the effectiveness of post-disaster recovery strategies. For example, other sectors can use strategies such as better inventory management, replace/upgrade technology, and conservation of resources to recapture lost production in a post-quake environment. All three sectors in this study employed such strategies as part of their recovery. Alongside, the mitigation factors used by the three sectors are not significantly different on most aspects. However, the accommodation sector being a people oriented industry, it is surprising that the importance of relationship with staff as a mitigation factor is lowest in comparison to the other two sectors. One plausible explanation may be related to the high use of seasonal workers in this industry.

Also, the findings suggest that the accommodation sector is less likely to plan for disasters, but rely on being adaptive and reacting to situations as they present themselves. From a

disaster management perspective, this sector is vulnerable with low planning or adaptive resilience. Improving resilience is necessary as a risk management technique (Dalziell & McManus, 2004). Hence, strategies for improving resilience in the accommodation should include three key aspects (McManus et al., 2008): (i) situation awareness whereby the sector as a whole and its individual players recognize they are part of a wider network, learning about types of emergency situations; (ii) management of keystone vulnerabilities, including components in the organizational system such as buildings/infrastructures, critical suppliers, relationship with key groups internally and externally, communication structures, and the perception of organizational strategic vision; (iii) adaptive capacity can be built through enhanced decision support systems, governance structures, and robust operations management systems. Given the importance of the accommodation sector to the Canterbury region, improving its resilience also has implications for community resilience.

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