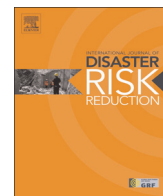




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## Industry sector recovery following the Canterbury earthquakes

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## ABSTRACT

The Canterbury sequence of earthquakes offers an opportunity to study the post-disaster recovery process of organisations and industry sectors. This study uses data collected via a survey of organisations affected by the 22 February 2011 earthquake in Canterbury, New Zealand. The industry sectors in the study are *construction* for its role in the rebuild, *information and communication technology* which is a regional high-growth industry, *trucking* for logistics, *critical infrastructure*, *fast moving consumer goods* (e.g. supermarkets) and *hospitality* to track recovery through non-discretionary and discretionary spend respectively. When compared to post-earthquake revenue changes, significant factors affecting organisations include customer issues, staff wellbeing and disruption to utilities. Also discussed is the differential effect these factors have on the industry sectors studied. This paper identifies the different factors that disrupted organisations in different sectors; explores the relative impact of these disruptions; and examines the differences in short- to medium-term recovery trends.

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## 1. Introduction

On 4 September 2010, the Canterbury region of New Zealand experienced a  $M_w$  7.1 earthquake. The epicentre was approximately 40 km west of Christchurch, New Zealand's second largest city. On 22 February 2011, a  $M_w$  6.3 aftershock located 13 km south-east of the Christchurch CBD caused vertical ground accelerations that were among the highest ever recorded in an urban environment [12,17]. The 22 February 2011 earthquake led to the loss of 185 lives. Parts of Christchurch's central business district (CBD) were cordoned off, restricting access for up to almost two years later. Throughout the greater Christchurch area, liquefaction, lateral spread and shaking caused unprecedented levels of damage to structures and utilities.

The estimated cost of recovery and reconstruction was between NZ\$30 and 40 billion [24]. This figure accounted for approximately 20% of New Zealand's GDP. After 22 February 2011, organisations in Canterbury faced the complex challenge of recovery from the cumulative effects of multiple earthquakes. These organisations operated in an environment of constant uncertainty as the earthquakes caused repeated closures, structural and

non-structural damage, utility disruption, and psycho-social stress of employees and customers (see [41,35,19,18]).

This paper forms part of a longer-term study whose primary objective is to investigate the ongoing impacts and recovery of organisations and sectors after the 4 September 2010 and 22 February 2011 earthquakes, by collecting information at different points in the recovery timeline. The paper identifies important factors organisations and sectors faced in this time period, as well as to what extent these organisations and sectors were affected by these different factors. Some of these factors are disruption to utilities and effects to staff and customers.

The objective of this paper is to add to the information and knowledge base of organisational and sectoral recovery after disaster by documenting results specifically from the 9-to-12 month period after a disaster event. The study also aims to compare how different sectors are affected by and recover from disasters.

For this study, organisations were sampled by industry sector. This gives a better understanding of the effects of disaster on different industry sectors and the organisations within these sectors. This information is useful for both industry sectors and recovery planners, as input for pre- and post-disaster recovery planning.

This paper is laid out as follows: the first part contains a discussion of some of the key studies that have addressed organisational and sectoral disaster recovery, an explanation of the method

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and rationale used to gather data as well as a description of the sample set. This is followed by results for organisations that reported being affected by the September 2010 and/or the February 2011 earthquakes and details the use of post-disaster trends in organisational revenue as a measure of recovery. Thereafter, the direct and indirect effects reported by sectors are discussed. These effects include organisational closure, factors that disrupted organisational operations, staffing adjustments and revenue changes are presented by sector. The effects are then compared to each other using the Kruskal–Wallis test. Lastly, there is discussion on the differential effects, of the earthquakes, to the various sectors.

### 1.1. Research context

Findings from disaster recovery studies detail differential impacts to organisations after disaster. For instance, Alesch et al. [2] and Nigg and Tierney [26] write that some organisations do not re-open. For those that do re-open, the length of operation after disaster and the impacts to revenue also differ. Some organisations open for a short while and then close, while others struggle to survive even a few years after a disaster event and then eventually close. Reasons for this include a change in the customer base, the decreased need for goods and services, the inability to access organisational premises, the inability to access materials needed for the business or decreased cash flow [23,37,38].

Furthermore, organisations are affected by both the direct and indirect effects of a disaster that could last for an extended period [5]. An example of a direct effect is structural damage to buildings caused by the ground motions of an earthquake [8]. Indirect effects are those not directly caused by the event itself. For instance, indirect losses such as decreased revenue could result from utilities interruption caused by a disaster [15,27,31]. Indirect impacts also include neighbourhood effects [21]. For example, location of an organisation next to a building that is damaged and cordoned off could lead to that organisation's closure. Organisational disruption, not only affects the economic health of that organisation, but inhibits the recovery of the organisation's employees, employees' families, and the communities that depend on them [22,25,9]. However, there is not a measure for how *individual* effects of a disaster affect different organisations and sectors. Understanding the impacts caused by individual factors is important for hazard mitigation and planning.

Studies addressing organisational recovery often include organisations from different industry sectors. However, intentional sampling, in a single study and for comparative analysis, of several industry sectors is rare. Of the few studies that have analysed the recovery of industry sectors after disaster, results show dissimilar recovery trajectories. For instance, Dahlhamer and Tierney [11] found that a larger proportion of recovered firms were from the manufacturing and construction sectors following the Northridge earthquake while Kroll [20] write that after the Loma Prieta earthquake, organisations from the retail and service sectors were more likely to suffer greater losses. Other work investigating sectoral recovery has addressed issues such as resilience, crisis management and recovery of individual industry sectors, for example, tourism [28,29]; transport [7]; rural (see [42,43]) tertiary education [32]; and construction [6,39].

Additionally, there is little agreement on the calculation or quantification of disaster effects to organisations. Some authors [13] use a loss of revenue, a measure that is easily understood while others [10] use the number of people collecting unemployment insurance in the wake of a disaster. Asgary et al. [3] as well as the Business Continuity Management Institute [4] uses the number of days an organisation is unavailable, that is, closed, as a measure of the effects of disaster. In other work, Zhang et al. [44] looked at impacts of organisational recovery from a community

perspective while Rose et al. [30] analysed recovery using a regional lens.

### 1.2. The Canterbury earthquake sequence

Since 4 September 2010, Canterbury had over 10,000 earthquakes of varying magnitudes. At least four events were of  $M_W$  6 or greater. Additionally, each event acted to reset the recovery clock. The earthquake and aftershock sequence can be seen in Fig. 1.

## 2. Method

The data utilised in this paper were collected using a questionnaire deployed to selected organisations in the Canterbury region from May to September 2011. The survey was deployed after the 22 February 2011 earthquake. Organisations were selected for the study using a stratified random sampling technique based on industry sector. Data were collected using Dillman's [14] total design method, adapted to this work. Prior to questionnaire dispatch, all the sample organisations were contacted and asked to verify the physical address the questionnaire should be mailed to. Contact was via fixed and mobile telephone, organisation website, industry association and social media, e.g. Facebook. The multiple means of contact helped to ensure that organisations not operating from their physical address could also be reached. At the time of surveying, some of the organisations that responded were still closed.

Questionnaires were mailed to the address given by the organisation. This was followed by a telephone call where organisations were given the option of completing the survey by phone or in a personal visit with a member of the research team, completing the survey online or returning it by post or e-mail. The multi-format approach was designed to cater for those organisations that might have relocated, closed or was too busy to complete the telephone survey during work hours. The flexible format approach to data collection helped to improve the response rate.

The survey was used to collect information regarding the direct and indirect impacts of the Canterbury earthquake sequence on organisations, as well as strategies organisations employed to recover. The survey also asked about organisational factors, supply chain issues, the types and extent of disruption, revenue changes, staffing changes, relocation and cash flow.

Similar to other disaster studies, e.g. Dietch and Corey [13], one aspect of this research is that the organisations followed were those that could be reached during the course of this study. Consequently, there is a possibility of survivor bias as there are no data from possible permanently closed organisations that were on the initial sample list, or that could not be reached by the authors. Information on why organisations may have closed permanently would be helpful to disaster researchers and policymakers.

However, data analysed by Statistics New Zealand [33] showed no significant (2.5%) business closure in Christchurch between February 2011 and February 2012. Furthermore, it should be noted that not all the organisations surveyed were foreordained to recover. For instance, Alesch [1] and Alesch et al. [2] detailed how some organisations failed 4–7 years after disaster events.

Industry sectors included in the study were selected in consultation with a panel of six experts and key players in recovery, resilience and the economies of Christchurch and Canterbury. One of the factors in selecting the sample was that we wanted to obtain a breadth of information about industry sectors that represented different aspects of the Canterbury economy. Although not all sectors were included, see Table 1 for sectors in the study, we tried to capture diverse perspectives on how different parts of the

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