

Rapid response research in Christchurch: Providing evidence for recovery decisions and for future theoretical research

Felicity Powell
Abigail Harding
Jared Thomas
Kate Mora

Opus International Consultants Ltd

© The Author(s) 2011. (Copyright notice)

Author correspondence:

Felicity Powell
Email: Felicity.Powell@opus.co.nz

Abstract

During the immediate response phase after a disaster event, decision-makers need urgent insight into the impacts of the disaster on affected communities so that support and policy attention are directed to those communities in most need. For researchers to assist decision-making in this vital period, there is a need to adapt their customary research approach in order to provide helpful information in a timely, inexpensive, and non-invasive manner. Traditional research techniques can be applied at a later date when recovery processes are well underway.

Using a case study approach, this paper reports on two research projects commenced after the Canterbury earthquake of 4 September 2010. This research, of necessity, took an applied approach, and, in one instance, employed remote datasets to reveal the impacts of the earthquake during the immediate response phase. In the light of these accounts, the modifications required of researchers to undertake rapid response research after a major hazard event are discussed. Provided the research process engaged in is technically rigorous, there is an opportunity to shift from applied, operational research to improve theoretical knowledge of the recovery phase.

Key words: disaster recovery research, Canterbury earthquake, research dissemination, rapid response research, recovery indicators

Introduction

Recovery after a natural hazard event is increasingly viewed as a dynamic and complex process with no

clear endpoint (Johnson 2010; Nigg 1995). Recovery is also often cited as the least understood phases of the disaster cycle with most current knowledge built on individual case studies of disasters (Chang 2010; Olshansky & Chang 2009). Over the last 20 years progress has been achieved in developing a multi-disciplinary understanding of the recovery process. Indeed in New Zealand, researchers have previously examined recovery from hazard events that include floods, volcanic eruptions and earthquakes (e.g. Becker & Richardson 2000; Becker *et al.* 2001; Johnston *et al.* 2000; Powell 2010). However, there is still no theory of recovery, no consistent definition of what recovery means, and no consensus on how it should be modelled, measured or tracked over time (Johnson 2010; Miles & Chang 2006). To address part of this knowledge gap, attention has been paid recently to identifying potential indicators of recovery (e.g. Brown *et al.* 2008; Chang 2010; Johnson 2010; Miles & Chang 2006).

One goal of research into recovery from hazard events is to provide well-grounded explanations of a range of social and behavioural phenomena across a range of different hazards. With generally no previous experience to go on, a community hit by a large disaster is dependent on researchers to synthesise lessons and provide guidance from what is already known about recovery processes (Olshansky & Chang 2009). Information can also be gleaned from new applied research of the disaster-hit community itself to ascertain impacts and to record people's experiences (King 2002). The immediacy and uncertainty after a disaster event leaves little option other than rapid fieldwork as a means of collecting perishable data on key disaster-related topics (King 2002; Myers 1993).

Adopting a case study approach, this paper reports on two research projects commenced after the Canterbury earthquake of 4 September 2010. These projects incorporate novel ways of conducting rapid, non-invasive research of relevance to the recovery effort. Following a brief review of the literature that relates to researching in the immediate aftermath of a major disaster, there is a description of the two projects. The opportunities and challenges experienced in undertaking research in the early recovery phase are outlined. Conclusions are drawn about the ways in which researchers must modify

their customary approach to deliver rapid response research, providing evidence for recovery practitioners that will later form the basis for theoretical research into the recovery process.

Researching disaster recovery in the immediate aftermath of an event

Though recovery is the least understood phase of the disaster cycle, there is a growing body of evidence on disaster recovery. Several studies have looked at the impacts of different hazard events on small businesses¹, allowing comparisons to be made between different hazards and different communities. In the first study to take a comprehensive view of the recovery process, Haas *et al.* (1977) examined four disasters² to extract common lessons on the rebuilding of cities after a disaster and to develop a conceptual framework of recovery. They recommended that post-disaster planners make quick decisions to reduce uncertainty amongst private decision-makers. Yet Olshansky and Chang (2009) observe that 'recovery is a fast-paced, information poor environment' (p.206), and that the central issue for post-disaster recovery is the tension between speed and deliberation. In this time compressed phase, there are two key influences of decisions: vision and resources, with the latter including financial, manpower and information resources (Johnson & Olshansky 2011).

Natural hazards researchers are able to play an important role by providing practitioners with guidance about what is already known about recovery from previous research and with information on the current hazard event based on new applied research. For those researchers who previously examined other disaster phases (that is emergency preparedness or emergency response), recovery research may entail engaging with a new audience (Quarantelli 1993). This may present a challenge for some researchers as different audiences have different timeframes, and material for each audience needs to be presented in different ways.

In addition to engaging with a new audience, a further shift is required from researchers in terms of the means used to disseminate their findings. Usually academic researchers favour peer-reviewed journals and conference proceedings to disseminate their findings

as their performance is judged primarily in terms of publications in well-regarded journals (Druckman 2000; Fothergill 2000). The urgency of the post-disaster situation requires the use of alternative means of dissemination as these more customary means will not meet the timeframes of potential end-users. Myers (1993) recommends that researchers succinctly present their material, and recognize the context in which their results may be applied to assist the end-user in interpreting results and applying them.

Aware that researchers may need to comply with funding institution's and university's requirements for academic publications, Fothergill (2000) suggests that researchers try to create results that are both theoretical and practical. Furthermore, the information flow must be two-way as end-users need to clearly define their problems so that researchers can address these needs (Myers 1993). This transition from theory-driven to applied research represents a further adjustment for researchers more accustomed to research programmes in which findings typically stimulate further investigation rather than having as an end point improved analysis of or solutions for particular problems (Druckman 2000).

The most frequently discussed risk of conducting research with affected communities is emotional distress (Collogan *et al.* 2004). Thus, it is important that research involving interaction with and data collection about participants is conducted in an ethical manner. Key aspects of 'ethical research' include the right to privacy, informed consent, protection of each participant's welfare, and research that does not involve deception (Barron Ausbrooks *et al.* 2009; Collogan *et al.* 2004; Dodds & Nuehring 1996; Richardson *et al.* 2009). Ideally, post-disaster research should address the needs of practitioners and communities within the disaster area. It is important to protect human research participants, but at the same time, researchers have a responsibility to undertake research to answer relevant questions and to disseminate any knowledge gained so it can be applied to benefit current and/or future disaster victims (Barron Ausbrooks *et al.* 2009; Collogan *et al.* 2004; Kilpatrick 2004; Richardson *et al.* 2009).

This background information on researching disaster recovery illustrates some of the modifications that researchers need to make to their approach to research when they commence investigations in the immediate aftermath of a hazard event. These modifications can be summarised as follows:

¹ Examples from the U.S.A. include Chang and Falit-Baiamont (2002) on the 2001 Nisqually earthquake; Kroll *et al.* (1991) on the 1989 Loma Prieta earthquake; Webb, Tierney and Dahlhamer (2000) on the Loma Prieta earthquake, Hurricane Andrew in 1992, the 1994 Northridge earthquake and the 1993 floods in Des Moines; and from New Zealand, Powell and Harding (2010) on the 2007 Gisborne earthquake.

² 1972 Rapid City flood; 1972 Managua, Nicaragua, earthquake; 1964 Alaska earthquake; 1906 San Francisco earthquake.

- 1) **Rapid fieldwork:** Because information is a vital part of the recovery process, rapid fieldwork is required to inform the quick decisions required of policy-makers. A further reason is the capture of perishable data;
- 2) **End-user engagement:** Researching recovery is likely to mean engaging with a new audience of end-users with different timeframes and different information needs from other end-users of disaster research. For researchers to address end-user's needs, end-users may become more involved in formulating research studies;
- 3) **Applied research:** The types of studies undertaken are liable to be applied projects which *analyse or solve operational problems* rather than more theory-driven work that seeks to *explain behaviour or processes*;
- 4) **Ethical considerations:** The need to collect and disseminate knowledge that will benefit affected communities should be balanced with ethical considerations;
- 5) **Dissemination of findings:** The presentation of research findings is likely to be different both in terms of its succinctness and the means of dissemination; and
- 6) **Rigorous and practical research:** Research should deliver results that are practical and rigorous, and that will add to the theoretical knowledge.

Responding to the 2010 Canterbury earthquake

Immediately following the 4 September 2010 Canterbury earthquake, succinct advice notes for policy-makers were compiled and circulated to local and central government. These advice notes contained key learnings from (a) earlier business recovery research undertaken in Gisborne, New Zealand, following the 2007 earthquake (Powell 2010; Powell & Harding 2010), and (b) psychosocial considerations with regards to billeting and temporary accommodation for displaced populations. Over October and November 2010, findings and advice arising from the earlier research were presented to end-users from local and central government, and recovery managers in Christchurch.

Rather than move into completely different research directions, studies were developed that were aligned to previous and intended research. Two research

projects were initiated after the earthquake and these are described in more detail below:

- a) An investigation of pedestrian footfall counts in the Christchurch CBD as a potential indicator of recovery and/or decline; and,
- b) A longitudinal study of population migration within the Canterbury region resulting from the earthquake.

A. Feasibility study of pedestrian traffic as a recovery indicator

Comments received when surveying businesses in Gisborne suggested that after its 2007 earthquake, pedestrian avoidance of seemingly damaged areas negatively affected businesses remaining open nearby. Road, building and footpath closures, as well as perceptions of personal risk, can reduce pedestrian traffic and thus business viability even when individual businesses escape direct damage themselves. Certainly under normal (non-disaster) circumstances, empirical evidence links retail store performance and pedestrian route-choice behaviour (Timmermans & Van der Waerden 1992). The 2010 Canterbury earthquake, therefore, provided the opportunity to investigate the feasibility of pedestrian footfall as an urban recovery indicator that could contribute in some way to the growing body of knowledge of such indicators (Brown *et al.* 2008; Johnson 2010). The reliability of the footfall data as a proxy measure of business recovery would be later authenticated by an intended survey of businesses located in the centre of Christchurch.

Student observers conducted manual pedestrian counts using tally counters at 12 sites throughout the CBD on a midweek day in each of October, November, December 2010 and February 2011 (see Figure 2). The sites were chosen based on the patterns of earthquake damage within the CBD, and to be comparable with sites used in an assessment of urban vitality in 2008 undertaken for the Christchurch City Council (Gehl Architects 2009). Pedestrian counts were recorded every quarter hour during two hours in the morning and two hours mid-afternoon. At the request of Christchurch City Council, in December and February, additional counts were undertaken for a further two hours covering the evening commute, and an alternative site was used in place of one of the original sites.

The study was to be replicated a number of times for a year to monitor progress towards recovery and to reveal areas likely to be at risk of decline due to fewer

potential customers. After each survey, short reports were circulated to end-users in Christchurch, including the City Council, a business association representing city centre businesses, and Canterbury Development Corporation, the organisation responsible for economic development in the city. Feedback from end-users was positive, and the researchers were invited to make an in-house presentation to the Council in November 2010. The reports were also posted on the website of the New Zealand Society for Earthquake Engineering's research clearing house and therefore made available to other researchers.

The total number of pedestrians recorded at each site on each counting days is shown in Figure 1. Between October and December, the total number of pedestrians recorded at all sites fell each month, with 12.8% fewer pedestrians overall in November, and a further fall of 4.1% by December. In February, the total number of pedestrians counted almost recovered to the October totals, being only 0.8% lower than the earlier number. At two of the sites (Colombo St D and Sol Square) pedestrian numbers altered little over the study period. Pedestrian numbers fell each month to December in 7 of the 11 sites, but numbers rebounded in February in all but two of these (High St and Worcester St B).

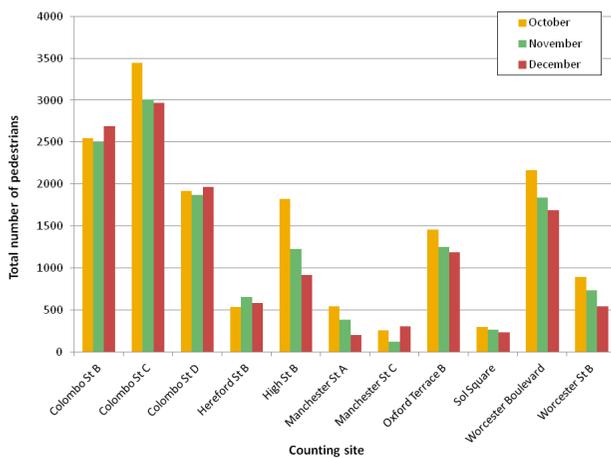


Figure 1: Total number of pedestrians recorded (10.30a.m.-12.30p.m. and 1.00p.m.-3.00p.m.)

There are a number of possible explanations for the observed decrease in pedestrian numbers over the first three months. The higher total number of pedestrians observed in October may have been artificially high because this was the only survey undertaken during school holidays. For the December count, being three weeks before Christmas, more pedestrians were anticipated but the low numbers observed may

be attributable to the unpleasant weather deterring shoppers. Similarly, the increase recorded in February may be in part due to fine weather. The full reopening of Manchester Street, part of which had been closed since September due to an unsafe building that had to be demolished, led to temporarily closed businesses in that area reopening by February, and this is likely to have resulted in more workers being in the CBD than in the preceding months.

A clear pattern of areas in the CBD at risk of decline due to low patronage emerged from the survey data (see Figure 2). The southern and eastern sides of the CBD experienced declining footfalls that may threaten the viability of businesses that remained open after the earthquake (Timmermans & Van der Waerden 1992). These findings supported anecdotal accounts of businesses in the south and eastern parts of the city experiencing hardship since the earthquake. At the same time, other sites to the north and west of the CBD appeared to be experiencing reasonable and even high pedestrian numbers. This part of the city contained the cultural quarter running from Cathedral Square to the Arts Centre and Gallery. With less damage to buildings in this area than to the east, this part of the CBD had fewer road closures that might deter pedestrians. Retail was dominated by chain stores, and this area seems to have maintained its popularity with shoppers and tourists after the earthquake. The relocation of the civic offices to this part of the CBD in September 2010 is also likely to be manifest in the higher pedestrian numbers.



Figure 2: Map of Christchurch CBD, showing counting sites and possible risk of decline.

From the results to date, it is concluded that by providing quantitative evidence regular pedestrian counts could potentially be a useful indicator of business recovery after a shock event so long as adequate contextual

information is also known (Harding & Powell 2011; Powell & Harding 2011). Pedestrian counting is a relatively simple and cost-effective complement to anecdotal evidence and more thorough surveys. It is a non-intrusive means of observational study that allows for the quick survey of sites and prompt analysis of data. Whilst the protocol for counting is simple, data collection must be rigorous to be comparable over time.

The reliability of this possible indicator was to be authenticated using data collected from a survey of CBD businesses, but that survey is on hold at the time of writing as the CBD remains cordoned off due to the devastating February 2011 earthquake. The relationship between footfall and turnover will now be verified using the value of credit and debit card transactions provided by Paymark, a major EFTPOS provider in New Zealand.

B. Post-earthquake migration within the Canterbury region

The postal service provider, New Zealand Post (NZ Post), has a mail redirection database in which people can register their change of address. Following the September 2010 earthquake, this database was analysed to provide an indication of household migration within the Canterbury region. This analysis was to achieve two aims; in the short term, to provide prompt migration information for recovery managers, while in the longer term to explore changes in migration patterns over time as an indicator of recovery.

Of those that register their change of address with NZ Post, 65% agree to have their details included in the publicly available relocation database. Each record can be purchased, with recent records being more expensive to acquire than older registrations. Data was purchased for September and October 2010 with the intention of continuing to purchase the data over at least a 12 month period following the earthquake.

To allow a baseline comparison, historic records from August 2008-August 2010 were also purchased. As a first stage, Statistical Chi-Square analyses were carried out, comparing relocations in September and October 2010 to relocations in the same months of 2008 and 2009. Census files were merged with the dataset to include the Area Unit, Ward, Territorial Local Authority (TLAs) and Regional Council areas of the listings. In addition, data from the Real Estate Institute of New Zealand (REINZ) on the number of house sales per month (which is publicly available on the Internet) was accessed for the same period to enable comparisons with house sales.

The numbers of relocations from August 2008 in Hurunui, Kaikoura, Mackenzie, Waitaki and Waimate districts are typically low, being often in single figures per month. The focus of analysis was therefore on household relocations for the TLAs of Ashburton, Christchurch, Selwyn, Timaru and Waimakariri (see Figures 3 and 4).

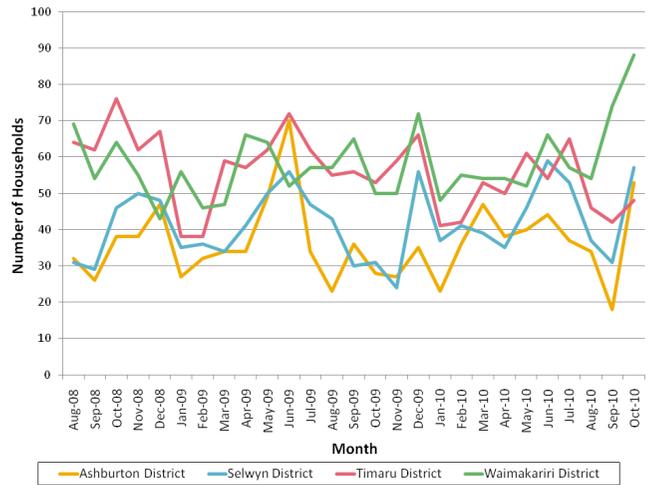


Figure 3: Frequency of household relocations in Ashburton, Selwyn, Timaru and Waimakariri districts, August 2008 – October 2010

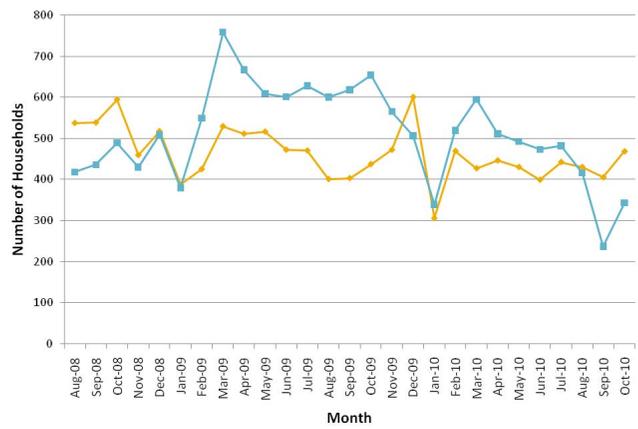


Figure 4: Frequency of household relocations and residential property sales in Christchurch City, August 2008 – October 2010

The number of household relocations in September 2010 was generally lower than usual in all but one of the TLAs in the Canterbury region; the exception was the Waimakariri district where more households relocated than normal, possibly due to this area being worst affected by the earthquake. Numbers rebounded in October with both Waimakariri and Selwyn districts showing significantly higher rates of relocation

than would be anticipated from the baseline data. Comparisons with house sales data in Christchurch and Kaiapoi were made that revealed there were more household relocations than house sales in both areas, suggesting that a greater number of people moved to rented accommodation than into newly purchased properties.

In the weeks following the September earthquake, there were a wide range of estimates of the number of people leaving the Canterbury region, many of which were not based on analysis of any data. Over time, a number of other datasets became available (e.g. school and electoral enrolments, electronic payment transactions), but the agencies responsible for these were reluctant to provide researchers access to the data, primarily due to privacy concerns. Comparisons with other secondary datasets can also be difficult due to different measurement units (e.g. the REINZ data was difficult to match to Census boundaries), but all can be used to form an overall picture of migration.

While datasets such as the NZ Post data are not without limitations, they provide a quick insight into changes in the number of household relocations around the Canterbury region, and the statistical analyses performed gave a scientific basis to migration estimates. The primary limitation of the dataset was that not every person that changes address notifies NZ Post, and of those that do, not all allow their details to be made available to others. In response to the more severe earthquake in February 2011, NZ Post made all of the records available to the government as this data was requested by recovery managers and policy-makers to inform migration estimates from and within Christchurch City for the prioritisation of resource allocation. The uptake of this research technique following the second earthquake is testament to its usefulness as a remote and non-invasive means of determining patterns of internal migration following a disaster event.

The transition to rapid response research

The literature on researching disaster recovery illustrated some of the modifications required by natural hazards researchers when they commence investigations into post-disaster recovery in the immediate aftermath of an event. Based on these likely modifications and following Richardson *et al.* (2009), a brief review of the key opportunities and challenges that arose during these two research projects is provided.

Opportunities

1. Undertaking rapid fieldwork

Following a disaster, it is essential that decision-makers quickly receive accurate information in order that they can make swift decisions to reduce uncertainty and facilitate recovery (Johnson & Olshansky 2011; Olshansky & Chang 2009). Both research projects were initiated within a few weeks of the earthquake. The pedestrian footfall study involved the application of a well-established technique to a new research context. Being simple and quick to operationalise, this study allowed the capture of perishable data on a monthly basis to provide timely trend information. It was identified that for findings to be robust, contextual knowledge is required, and that a clear protocol for data collection is essential for data to be comparable.

The internal migration study involved the novel application of an existing remote dataset. The benefits and limitations of using secondary data sources are well-known (Kiecolt & Nathan 1985). The primary advantages in the context of the internal migration study were time and resource savings. The acquisition of data for NZ Post was relatively easy to do quickly, as the data was set up for a commercial nature and so could be purchased (whereas other datasets can require lengthy access arrangements). The limitations of secondary data analysis are intrinsic to the original survey method (Kiecolt & Nathan 1985), and the key limitations of the NZ Post database were discussed earlier. The advantages of prompt data provision to inform the recovery effort far outweigh the limitations associated with the dataset.

2. Engaging a new audience of end-users

In the event of a disaster, researchers are likely to have to develop a new audience of end-users to whom they disseminate knowledge arising from previous research and information on the current event based on new research (Quarantelli 1993). The utilisation of existing relationships to encourage trust (for example, the use of local contacts if the research team is not based locally), and evidence of the ability to help the recovery effort (such as the use of easily digestible advice notes or targeted presentations) both help engagement with new end-users. For researchers to deliver the information that end-users require, it is important that end-users are given the opportunity to define the problems, so that there is a two-way flow of information (Myers 1993). An instance of this is evident

in the modification of the pedestrian footfall survey after feedback from Christchurch City Council indicated that an additional survey period and alternative survey site would be helpful.

3. Commencing applied research projects

In order that researchers can promptly provide the information required by end-users, researchers need to shift their approach from being theory-driven to delivering solutions to distinct problems (Druckman 2000). Both of these studies represent this necessary transition to applied research. First, the pedestrian footfall study sought to identify which parts of the CBD were vulnerable to a loss in business vitality due to a decline in the number of potential customers that would be more accurate than the anecdotal accounts of businesses. Second, the purpose of the migration study was to deliver more accurate information on the nature of population movements from an information source that was readily available, relatively reliable, and up-to-date. Alternative sources of information on population movements were either not accessible to researchers and policy-makers due to confidentiality or would entail a substantial lag in the delivery of such information, for example updates to the electoral roll, that would not meet end-users' desired timeframes.

Challenges

1. Complying with ethical considerations

It is important that researchers respect the needs of human research participants, and at the same time gather information that will deliver research to assist their recovery (Barron Ausbrooks *et al.* 2009; Kilpatrick 2004). Studies were therefore purposefully developed that avoided the requirement to interact directly with potentially traumatised people via the use of an observational technique (pedestrian footfall survey), and the analysis of existing remote datasets (migration study).

2. Modifying the dissemination of research findings

For various reasons, academic researchers favour peer-reviewed journals and conference proceedings to disseminate knowledge arising from their research (Druckman 2000; Fothergill 2000). The urgency of the recovery situation requires that alternative means of dissemination are used that will facilitate end-user uptake and meet their desired timeframes (Myers 1993). For these reasons, new reporting formats were adopted

in the studies outlined in this paper, including the preparation of advice notes circulated to policy-makers in the first days after the earthquake. Furthermore as each phase of the two studies was completed, short reports were released to end-users. Whilst this prompt and regular reporting was time-consuming, it facilitated communication with and feedback from end-users. Research findings were also presented to end-users in Christchurch, and made available to other researchers on the Internet. At the same time as this additional direct contact with end-users and regular reporting, preparation of conference papers and journal articles continued (Harding & Powell 2011; Powell & Harding 2011).

3. Delivering rapid response research that is both practical and rigorous

To comply with institutional requirements for academic publications, it is recommended that recovery researchers deliver research that is both practical and rigorous (Fothergill 2000). In the immediate aftermath of the 2010 earthquake, resources were initially directed to providing relevant knowledge from earlier research. Then, new research projects were developed that would promptly deliver information to practitioners.

The challenges in terms of the new research were two-fold: first, the research had to be rigorous and scientific to ensure accurate reporting in the short term, and to provide robust evidence for the more theoretical work to follow afterwards; and second, with resources re-directed to aid recovery, there was a risk that existing funding would be quickly depleted, leaving little for theoretical work once the urgency for information had passed.

Addressing the first of these, proven techniques of data collection and analysis were used in both studies. For the pedestrian footfall study, it was essential that data collected across the different sites and on different occasions were comparable. Therefore the student observers received training in the observational technique to be used and were closely monitored by an experienced researcher. In the migration study, the remote datasets were scrutinised before analysis to check for discrepancies and the limitations of the datasets were understood. Analysis of the datasets used a well-established and appropriate statistical technique, Chi-Square analysis, and was undertaken by experienced statisticians. In both studies, data analysis and reporting accuracy were verified by independent reviewers prior to the release of reports.

To meet the challenge of delivering theoretical research after the emergency had passed, studies were purposefully aligned to intended research. Furthermore, it was planned that data captured should provide the evidence for scientific investigations into the recovery phase of the disaster cycle. The footfall study entailed the capture of perishable data on the number of people frequenting different parts of the CBD. In the short term, the benefit of this data for end-users was a more accurate understanding of pedestrian avoidance and its potential impact on business vitality. The longer term benefit of the research is the subsequent testing of pedestrian footfall as a reliable recovery indicator that would add to the academic knowledge on this topic. Furthermore, the footfall data would be reconciled with the intended business survey, adding a level of richness to that later study as the effect of the earthquake's impacts on potential customers would be known.

As with the footfall study, the immediate benefit of the migration study was to deliver timely information on population movements due to the earthquake to provide an evidence base to appropriately allocate resources to provide for the welfare of communities and mitigate community abandonment. The NZ Post data was found to be the best indicator of movements available that met the urgent timeframe of recovery managers. The intention was to monitor movements over a longer period, identifying when people who left the region due to the earthquake returned. With the database revealing identities and contact details, people's motivations and migration patterns could be investigated at a later date through surveys and/or interviews, establishing a more scientific investigation of people's behaviour.

Conclusions

Severe seismic events are fortunately infrequent in New Zealand, and rarely affect its major urban centres. The 2010 earthquake in Canterbury presented researchers with a relatively unique opportunity to investigate the post-disaster recovery of the country's second largest city, and to provide useful knowledge to practitioners that would assist recovery.

There is a potential danger that evidence-based decision-making is missing from the recovery phase because researchers do not provide a fast enough response. In order to provide helpful information on post-disaster recovery in a timely, inexpensive and non-invasive manner, it is essential that customary approaches to research and its dissemination are

modified and that potential challenges are overcome.

In the longer term, data captured during rapid response research can become an essential element of more theory-driven and scientific research that will explain recovery behaviour or processes, and will improve understanding of this phase of the disaster cycle. For this reason, it is essential that data collection techniques used by researchers undertaking rapid response research are as scientific and rigorous as they would ordinarily employ.

References

- Barron Ausbrooks, C. Y., Barrett, E. J. & Martinez-Cosio, M. (2009). Ethical issues in disaster research: Lessons from Hurricane Katrina. *Population Research and Policy Review*, 28, 93-106.
- Becker J. & Richardson V. (2000). The November 1999 Queenstown floods and Frankton landslide. *Institute of Geological and Nuclear Sciences Report*, 2000/12.
- Becker J., Smith R., Johnston D., & Munro A. (2001). Effects of the 1995-1996 Ruapehu eruptions and people's perceptions of volcanic hazards after the event. *The Australasian Journal of Disaster and Trauma Studies*, 1 (online Journal).
- Brown, D., Saito, K., Spence, R. & Chenvidyakarn, T. (2008). Indicators for measuring, monitoring and evaluating post-disaster recovery. Presented at the 6th International Workshop on Remote Sensing for Disaster Response for Disaster Response, 11-12 September. University of Pavia, Italy.
- Chang S.E. (2010). Urban disaster recovery: a measurement framework and its application to the 1995 Kobe earthquake. *Disasters*, 34 (2), 303-327.
- Collogan, L. K., Tuma, F., Dolan-Sewell, R., Borja, S. & Fleischman, A. R. (2004). Ethical issues pertaining to research in the aftermath of disaster. *Journal of Traumatic Stress* 17 (5), 363-372.
- Dodds, S. & Nuehring, E. (1996). A primer for social work research on disaster. *Journal of Social Service Research*, 22 (1&2), 27-56.
- Druckman, D. (2000). The social scientist as consultant, *American Behavioural Scientist*, 43 (10), 1565-1577.
- Fothergill, A. (2000) Knowledge transfer between researchers and practitioners, *Natural Hazards Review*, 1 (2), 91-98.
- Gehl Architects (2009). *Christchurch public space public life*. Accessed from <http://www.ccc.govt.nz/cityleisure/projectstoimprovechristchurch/publicspacepubliclifestudy/index.aspx> on 8 September 2010.
- Haas, J. E., Kates, R. W. & Bowden, M.J. (eds.) (1977). *Reconstruction Following Disaster*. Cambridge, Massachusetts: MIT Press.
- Harding, A.J.M. & Powell, F.I. (2011). Variations in Pedestrian Traffic Count in Christchurch due to the September 2010 Darfield (Canterbury) Earthquake. Proceedings of the Ninth Pacific Conference on Earthquake Engineering: Building an

- Earthquake-Resilient Society, 14-16 April. Auckland, New Zealand.
- Johnson, L.A. (2010). Developing a management framework for community recovery following extreme events, Paper No. 1756, *Proceedings of the 9th U.S. National and 10th Canadian Conference on Earthquake Engineering*, July 25-29, Toronto, Canada.
- Johnson, L.A. & Olshansky, R.B (2011). Recovery of the whole community, PERI Symposium: Community Recovery from Disaster. Downloaded from <https://www.riskinstitute.org/peri/content/view/1118/5/> on 19 April 2011.
- Johnston D.M., Houghton B.F., Neall V.E., Ronan K.R., & Paton D. (2000). Impacts of the 1945 and 1995-1996 Ruapehu eruptions, New Zealand: an example of increasing societal vulnerability. *Geological Society of America Bulletin*, 112, 720-729.
- Kiecolt, K.J. & Nathan, L.E. (1985). *Secondary analysis of survey data*. Series: Quantitative applications in the social sciences. California, USA: Sage Publications, Inc.
- King, D. (2002). Post disaster surveys: experience and methodology. *Australian Journal of Emergency Management*, 17 (3), 39-47.
- Kilpatrick, D. G. (2004). The ethics of disaster research: A special section. *Journal of Traumatic Stress* 15 (5), 361-362.
- Miles, S.B. & Chang, S.E. (2006). Modelling community recovery from earthquakes, *Earthquake Spectra*, 22 (2), 439-458.
- Myers, M.F. (1993). Bridging the gap between research and practice: The Natural Hazards Research and Applications Information Center, *International Journal of Mass Emergencies and Disasters*, 11 (1), 41-54.
- Nigg, J.M. (1995). Disaster recovery as a social process. Wellington after the quake: The challenge of rebuilding. Wellington New Zealand: The New Zealand Earthquake Commission.
- Olshansky, R.B. & Chang, S. (2009). Planning for disaster recovery: emerging research needs and challenges, in H. Blanco and M. Alberti (eds.) Shaken, shrinking, hot, impoverished and informal: Emerging research agendas in planning, *Progress in Planning*, 72, 200-209.
- Powell, F. (2010). Urban earthquake events and businesses: Learning from the 2007 Gisborne earthquake. *The Australasian Journal of Emergency Management*, 25 (3), 54-59.
- Powell, F. & Harding, A. (2010). Business Recovery and the Rebuilding of Commercial Property. In A. Harding (Ed.), Shaken up: Proceedings of a workshop on recovery following the Gisborne Earthquake, 7 December 2009. Lower Hutt: Opus International Consultants Ltd.
- Powell, F. & Harding, A. (2011). Using pedestrian traffic as an indicator of urban recovery: An Ongoing Case Study of Christchurch CBD. 2011 NZPI Planning Conference, 29 March-1 April. Wellington, New Zealand.
- Quarantelli, E.L. (1993). Converting disaster scholarship into effective disaster planning and managing: Possibilities and limitations, *International Journal of Mass Emergencies and Disasters*, 11 (1), 15-39.
- Richardson, C., Plummer, C. A., Barthelemy, J. J. & Cain, D. S. (2009). Research after natural disaster: Recommendations and lessons learned. *Journal of Community Engagement and Scholarship* 2 (1), 3-11.
- Timmermans, H. & Van der Waerden, P. (1992). Store performance, pedestrian movement and parking facilities. In: Heinritz G. (ed.), *The Attraction of Retail Locations*. Verlag Michael Lassleben, Kallmünz/Regensburg.